Texas Department of Transportation

100% CD
SPECIFICATIONS
Volume 1

PRESIDIO MAINTENANCE FACILITY

Site No: 249007
Building No: 248220

EL PASO DISTRICT #24
PRESIDIO MAINTENANCE FACILITY
PRESIDIO COUNTY, TEXAS

Project No: 24-470420004

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: 7/19/2021

TABLE OF CONTENTS

DIVISION 04 – MASONRY

DIVISION 05 – METALS

DIVISION 06 – WOOD, PLASTIC, & COMPOSITES

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

DIVISION 08 – OPENINGS

DIVISION 09 – FINISHES

DIVISION 10 – SPECIALTIES

DIVISION 11 – EQUIPMENT – NOT USED

DIVISION 12 – FURNISHINGS

DIVISION 13 – SPECIAL CONSTRUCTION

DIVISION 14 – CONVEYING EQUIPMENT

DIVISION 15 through 21 – NOT USED

DIVISION 22 – PLUMBING

DIVISION 32 – EXTERIOR IMPROVEMENTS

DIVISION 33 – UTILITIES

ATTACHMENTS

(SE) Structural Engineers TOC with Seal and Signature; Cover listed sections in Divisions 03, 06, and 31

(CE) Civil Engineers TOC with Seal and Signature; Cover CE listed sections in Divisions 01, 02, 03, 31, 32, and 33.

(LA) Landscape Architect TOC with Seal and Signature; Cover listed sections in Division 32

(DC) Communications Designer TOC with Seal and Signature; Cover listed section in Division 27 & Division 28

(MEP) Mechanical, Electrical and Plumbing Engineers TOC with Seal and Signature; Cover listed sections in Divisions 22, 23, and 26

(FUEL) Fuel TOC with Seal and Signature, Cover listed section in Division 23

CONSULTANT KEY .

Key	Discipline	Company, City, and Contact	Telephone
AHC	Hardware Consultant	Allegion San Antonio, TX	
	Hardware Contact	RB Sontag	
CE	Civil Engineer	Jones & Carter, Inc 4350 Lockhill Selma Rd., Ste. 100 San Antonio, TX 78249	(210) 546-0084
	CE Contact	Joe York	(210) 546-0084
DC	Data & Communications	Combs Consulting Group 901 MoPac Expressway, Bldg. 1, Ste. 300 Austin, TX 78746	(913)
	DC Contact	Name	(913)215-2601
LA	Landscape Architect	Asakura Robinson 1224 E. 12th Street, Suite 310 Austin, TX 78702	(512)351-9601
	LA Contact	Margaret Robinson	(832)236-4493
MEP	Mechanical, Electrical, & Plumbing Engineers	Encotech Engineering Consultants, Inc. 8500 Bluffstone Cove, Ste. 103 Austin, TX 78759	(512)338-1101
	Project Manager	Sarah Migle	(512)758-7592
SE	Structural Engineers	JQ Infrastructure, LLC 108 Wild Basin Road, Ste. 350 Austin, TX 78746	(512) 474-9094
	SE Contact	Conner Maines	(214) 623-5881
FUEL		CDS Muery	
		Rick Berry	

END OF TABLE OF CONTENTS (TOC)

CIVIL TABLE OF CONTENTS

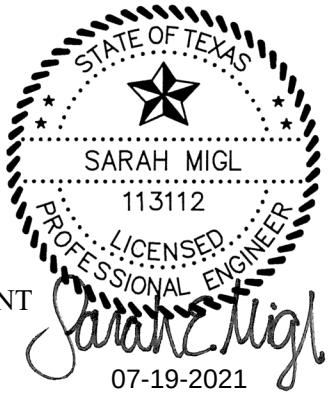
TxDOT Presidio Maintenance Facility
July 19, 2021
Specification TOC

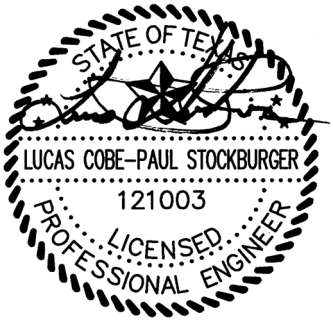
27 13 43 – Telecommunications
28 13 00 – Security System

8200 IH-10 West, Suite 103 • San Antonio, Texas 78230 • Voice: 210-698-7887
901 South Mopac, Building 3, Suite 400 • Austin, Texas 78746 • Voice: 512-433-2696 • Fax: 512-476-2252

TABLE OF CONTENTS

MEP TABLE OF CONTENTS





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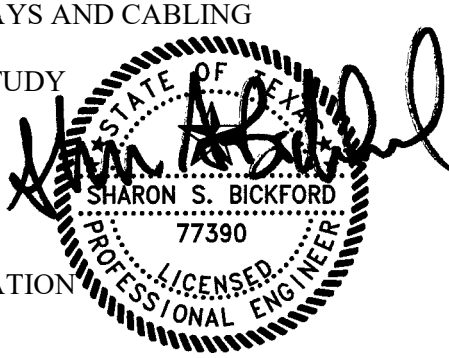
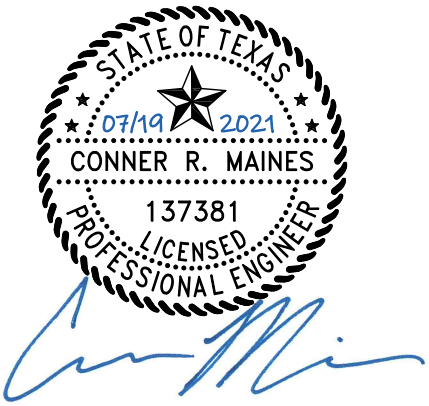


07-19-2021

STRUCTURAL TABLE OF CONTENTS



FUEL SYSTEM TABLE OF CONTENTS

Richard N Berry
7-19-21

Texas Department of Transportation

100% CD
SPECIFICATIONS
Volume 2

PRESIDIO MAINTENANCE FACILITY

Site No: 249007
Building No: 248220

EL PASO DISTRICT #24
PRESIDIO MAINTENANCE FACILITY
PRESIDIO COUNTY, TEXAS

Project No: 24-470420004

TEXAS DEPARTMENT of TRANSPORTATION
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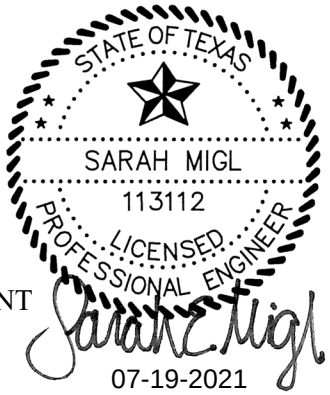

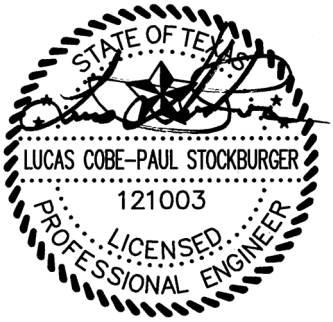

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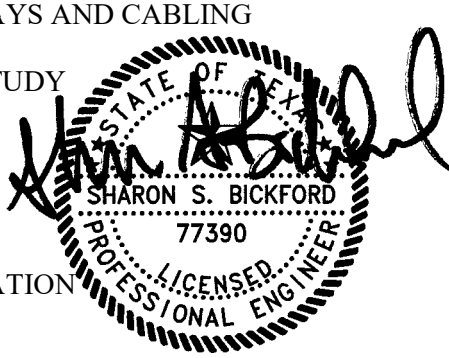

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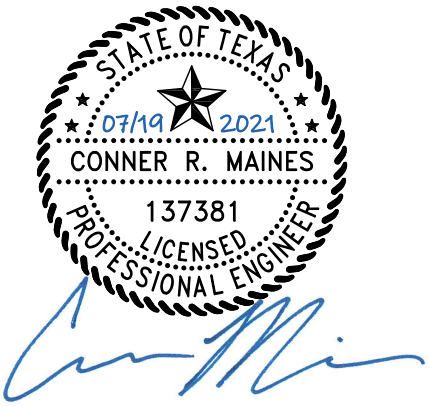

FUEL SYSTEM TABLE OF CONTENTS

Richard N Berry
7-19-21

STATE LET BUILDING CONTRACT

NEW PRESIDIO MNT FACILITY

LOCATION:	**16365 FM 170**
CITY/ST/ZIP:	**PRESIDIO, TEXAS 79845**
COUNTY:	**PRESIDIO**
DISTRICT:	**EL PASO**
SITE NO:	**249007**
BLDG NO:	**248220**
PROJECT ID:	**24-470420004-REBID**
ESTIMATED COST:	**$9,227,241.00**
BID GUARANTY or BID BOND:	**$100,000.00**
PRE-BID DATE, TIME:	**DECEMBER 1, 2021 @ 10:00 AM MT**
PRE-BID LOCATION:	**See Instructions to Bidders page**
BID DATE, TIME via WebEx:	**JANUARY 4, 2022 @ 1:00 PM CT**
BIDS MUST BE RECEIVED BY:	**NOON (12:00 PM CT) FOR 1:00 PM CT 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 CT) 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 PRESIDIO MNT FACILITY

LOCATION:	16365 FM 170
CITY/ST:	PRESIDIO, TEXAS 79845
COUNTY:	PRESIDIO
DISTRICT:	EL PASO
SITE NO:	249007
BLDG NO:	248220
PROJECT ID:	24-470420004-REBID
ESTIMATED COST:	$9,227,241.00
BID GUARANTY or BID BOND:	$100,000.00
PRE-BID DATE, TIME:	DECEMBER 1, 2021 @ 10:00 AM MT
BID DATE, TIME:	JANUARY 4, 2022 @ 1:00 PM CT
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:	BYRON HICKS, P.E.
DIVISION:	38-SSD (SUPPORT SERVICES DIVISION)
ADDRESS:	125 E 11TH ST (RA 150, 4N), AUSTIN, TX 78701
PHONE NUMBER:	(512) 416-3005
E-MAIL:	Byron.Hicks@txdot.gov

NAME OF TxDOT CONSTRUCTION PROJECT MANAGER:

PROJECT MANAGER:	HECTOR "ISAAC" ACOSTA
DIVISION:	38-SSD (SUPPORT SERVICES DIVISION)
ADDRESS:	125 E 11TH ST (RA 150, 4N), AUSTIN, TX 78701
PHONE NUMBER:	(806) 392-2098
E-MAIL:	Hector.Acosta@txdot.gov

NAME & ADDRESS OF THE ARCHITECT/ENGINEER:

PROJECT MANAGER:	MARMON MOK
CONTACT NAME:	STEPHEN LARA
ADDRESS:	1020 NE LOOP 410, SAN ANTONIO, TEXAS 78209
PHONE NUMBER:	(210) 223-9495
E-MAIL:	lara@marmonmok.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
- ☐ EARLY PAYMENT PROGRAM 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
- ☐ SLBC INFORMATION PAGE
- ☐ LUMP SUM BID SHEET
- ☐ ALLOWANCES (if applicable)
- ☐ AUTHORIZED SIGNATURES / CERTIFICATION OF INTEREST IN OTHER BID PROPOSALS
- ☐ 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 CT) on the Letting Date.
The bid reading will begin at 1:00 PM CT.

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: EL PASO

COUNTY: PRESIDIO

LOCATION: 16365 FM 170

PROJECT ID: 24-470420004-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: EL PASO

COUNTY: PRESIDIO

LOCATION: 16365 FM 170

PROJECT ID: 24-470420004-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: EL PASO

COUNTY: PRESIDIO

LOCATION: 16365 FM 170

PROJECT ID: 24-470420004-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:	EL PASO
COUNTY:	PRESIDIO
LOCATION:	16365 FM 170
PROJECT ID:	24-470420004-REBID

STATE LET BUILDING CONTRACT (SLBC)

WORK CONSISTING OF:	**NEW PRESIDIO MNT FACILITY**		
LOCATED AT:	16365 FM 170		
City/State:	PRESIDIO, TEXAS 79845	Site Number:	249007
County:	PRESIDIO	Building Number:	248220

Bids for the above work will be opened and read:	**JANUARY 4, 2022 @ 1:00 PM CT**		
Bids must be received by NOON (12:00 PM CT) 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:	BYRON HICKS, P.E.
PD PM Address:	125 E 11TH ST (RA 150, 4N), AUSTIN, TX 78701
PD PM Phone No:	(512) 416-3005
PD PM Email:	Byron.Hicks@txdot.gov
CONSTRUCTION PHASE	
Project Manager:	HECTOR "ISAAC" ACOSTA
CPM Address:	125 E 11TH ST (RA 150, 4N), AUSTIN, TX 78701
CPM Phone No:	(806) 392-2098
CPM Email:	Hector.Acosta@txdot.gov

Estimated Cost of Work :	$9,227,241.00
Proposal Guaranty Check or Bid Bond:	$100,000.00

Pre-Bid Conference:	DECEMBER 1, 2021 @ 10:00 AM MT
Pre-Bid On-Site Location:	N/A
Pre-Bid Virtual Location:	https://txdot.webex.com/
Pre-Bid Virtual Access Code/Password:	230 354 64350 / Fg3Cp28Npw7

Consultant:	MARMON MOK
Contact Name:	STEPHEN LARA
Address:	1020 NE LOOP 410, SAN ANTONIO, TEXAS 78209
Phone No:	(210) 223-9495
Email:	lara@marmonmok.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.

updated March 05, 2021

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 540 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

AUTHORIZED SIGNATURE PAGE FOR STATE LET BUILDING CONTRACT (SLBC)

NEW PRESIDIO MNT FACILITY

LOCATION:	16365 FM 170	PROJECT ID:	24-470420004-REBID
CITY/ST:	PRESIDIO, TEXAS 79845	COUNTY:	PRESIDIO
SITE NO:	249007	DISTRICT:	EL PASO
BLDG NO:	248220		

ESTIMATED COST: $9,227,241.00
BID GUARANTY or BID BOND: $100,000.00
BID DATE, TIME: JANUARY 4, 2022 @ 1:00 PM CT

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:***

_____

_____

_____

_____

CERTIFICATION OF INTEREST IN OTHER BID PROPOSALS FOR THIS WORK

By signing this proposal, the bidding firm and the signer certify that the following information, as indicated by checking "Yes" or "No" below, is true, accurate, and complete.

A. Quotation(s) have been issued in this firm's name to other firm(s) interested in this work for consideration for performing a portion of this work. (**REQUIRED** - **must** check one, "YES" or "NO")

_____ YES
_____ NO

B. If this proposal is the low bid, the bidder agrees to provide the following information prior to award of the contract.

1. Identify firms which bid as a prime contractor and from which the bidder received quotations for work on this project.
2. Identify all the firms which bid as a prime contractor to which the bidder gave quotations for work on this project.

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: EL PASO

COUNTY: PRESIDIO

LOCATION: 16365 FM 170

PROJECT ID: 24-470420004-REBID

PROPOSAL TO THE TEXAS TRANSPORTATION COMMISSION

NEW PRESIDIO MNT FACILITY

16365 FM 170 , PRESIDIO, TEXAS 79845

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 540 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 (including 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.**
5. **That, where applicable, we agree to purchase products and materials produced in this state when they are available at a price and time comparable to products and materails produced outside this state per TAC Sec. 2155.4441**
6. **Acknowledges receipt of all contractual documents including (if issued) proposals, attachments, special conditions, specifications, drawings, and addenda.**

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 PRESIDIO MNT FACILITY

LOCATION:	**16365 FM 170**
CITY/ST:	**PRESIDIO, TEXAS 79845**
COUNTY:	**PRESIDIO**
DISTRICT:	**EL PASO**
SITE NO:	**249007**
BLDG NO:	**248220**
PROJECT ID:	**24-470420004-REBID**
ESTIMATED COST:	**$9,227,241.00**
BID GUARANTY or BID BOND:	**$100,000.00**
PRE-BID DATE, TIME:	**DECEMBER 1, 2021 @ 10:00 AM MT**
BID DATE, TIME:	**JANUARY 4, 2022 @ 1:00 PM CT**
BIDS MUST BE RECEIVED BY:	**NOON (12:00 PM CT) FOR 1:00 PM CT 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: **24-470420004-REBID** County: **PRESIDIO**

Description: **NEW PRESIDIO MNT FACILITY** District: **EL PASO**

PRE-BID MEETING

PRE-BID MEETING may be conducted on-site, virtual via WebEx, or both as indicated below.

PRE-BID MEETING DATE/TIME: **DECEMBER 1, 2021 @ 10:00 AM MT**

ON-SITE: **N/A**

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

WebEx Meeting number (access code): **230 354 64350** Password: **Fg3Cp28Npw7**

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

Join from a video system or application Dial: 230 354 64350 @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: 230 354 64350 .txdot@lync.webex.com

BID LETTING

BID LETTING will be conducted as an open meeting AND virtually via WebEx meeting.

Bids for this project will be read: **JANUARY 4, 2022 @ 1:00 PM CT**

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): **172 307 2049** 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 CT 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 # 24-470420004-REBID

   ** Original endorsed / embossed Bid Bond or Bid Guarantee Check **MUST BE MAILED IN OR HAND DELIVERED AND PRESENT BY 12:00 PM CT 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 CT, 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: 06/16/2021

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 in the following instances;

3.4.5.1 at contract execution for contracts awarded by the Commission;

3.4.5.2 at contract execution for contracts awarded with an award amount of $1,000,000 or more;

3.4.5.3 any time an existing contract increases in value to $1,000,000 or more due to changes in the contract;

3.4.5.4 any time there is an increase of $1,000,000 or more to an existing contract (change orders, extensions, and renewals); or

3.4.5.5 when there is a change to the information in the Form 1295, when the form was filed for an existing contract.

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 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.

CONFLICT OF INTEREST CERTIFICATION

Pursuant to Texas Government Code Section 2261.252(b), the Department is prohibited from entering into contracts in which Department officers and employees have a financial interest.

By signing the Contract, the Contractor certifies that it is not prohibited from entering into a Contract with the Department as a result of a financial interest as defined under Texas Government Code Section 2261.252(b), and that it will exercise reasonable care and diligence to prevent any actions or conditions that could result in a conflict of interest with the Department.

The Contractor also certifies that none of the following individuals, nor any of their family members within the second degree of affinity or consanguinity, owns 1% or more interest or has a financial interest as defined under Texas Government Code Section 2261.252(b) in the Contractor:

- Any member of the Texas Transportation Commission; and
- The Department's Executive Director, General Counsel, Chief of Procurement and Field Support Operations, Director of Procurement, and Director of Contract Services.

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

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.

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."

Texas Department of Transportation

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E-Verify System
Instructions for Facility-Related Contracts

1. If your company is not already registered, register here: https://www.e-verify.gov/
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.e-verify.gov/contact-us
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 must submit the "E-Verify Memorandum of Understanding for Employers".

To obtain a copy of employer's fully executed MOU, log into the E-Verify system above.
Select Company
Select Edit Profile
Go to MOU tab at the bottom of the page

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

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

Certification Regarding Disclosure of Public Information

Pursuant to Subchapter J, Chapter 552, Texas Government Code, contractors executing a contract with a governmental body that results in the expenditure of at least $1 million in public funds must:

1) preserve all contracting information* as provided by the records retention requirements applicable to Texas Department of Transportation (TxDOT) for the duration of the contract,
2) on request of TxDOT, promptly provide any contracting information related to the contract that is in the custody or possession of the entity, and
3) on completion of the contract, either:
    A. provide, at no cost to TxDOT, all contracting information related to the contract that is in the custody or possession of the entity, or
    B. preserve the contracting information related to the contract as provided by the records retention requirements applicable to TxDOT

The requirements of Subchapter J, Chapter 552, Government Code, may apply to this contract, and the contractor or vendor agrees that the contract can be terminated if the contractor or vendor knowingly or intentionally fails to comply with a requirement of that subchapter.

By entering into Contract, the Contractor agrees to:

- provide, or make available, to TxDOT and any authorized governmental investigating or auditing agency all records, including electronic and payment records related to the contract, for the same period provided by the records retention schedule applicable to TxDOT, and
- ensure that all subcontracts include a clause requiring the same.

* As defined in Government Code §552.003, "Contracting information" means the following information maintained by a governmental body or sent between a governmental body and a vendor, contractor, potential vendor, or potential contractor:

1) information in a voucher or contract relating to the receipt or expenditure of public funds by a governmental body;
2) solicitation or bid documents relating to a contract with a governmental body;
3) communications sent between a governmental body and a vendor, contractor, potential vendor, or potential contractor during the solicitation, evaluation, or negotiation of a contract;
4) documents, including bid tabulations, showing the criteria by which a governmental body evaluates each vendor, contractor, potential vendor, or potential contractor responding to a solicitation and, if applicable, an explanation of why the vendor or contractor was selected; and
5) communications and other information sent between a governmental body and a vendor or contractor related to the performance of a final contract with the governmental body or work performed on behalf of the governmental body.

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, as defined in Government Code §808.001, 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. “Boycott” means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes.

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

CERTIFICATION TO NOT BOYCOTT ENERGY COMPANIES

Pursuant to Texas Government Code §2274.002, the Department must include a provision requiring a written verification affirming that the Contractor does not boycott energy companies, as defined in Government Code §809.001, and will not boycott energy companies 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 energy companies and will not boycott energy companies during the term of this contract. “Boycott” means taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with a company because the company: (1) engages in the exploration, production, utilization, transportation, sale, or manufacturing of fossil fuel-based energy and does not commit or pledge to meet environmental standards beyond applicable federal and state law; or (2) does business with a company described by (1).

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

CERTIFICATION TO NOT DISCRIMINATE AGAINST FIREARM ENTITIES OR FIREARM TRADE ASSOCIATIONS

Pursuant to Texas Government Code §2274.002, the Department must include a provision requiring a written verification affirming that the Contractor:

1) does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association, as defined in Government Code §2274.001, and
2) will not discriminate against a firearm entity or firearm trade association 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 discriminate against a firearm entity or firearm trade association as described and will not do so during the term of this contract. "Discriminate against a firearm entity or firearm trade association" means, with respect to the entity or association, to: (1) refuse to engage in the trade of any goods or services with the entity or association based solely on its status as a firearm entity or firearm trade association; (2) refrain from continuing an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association; or (3) terminate an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association. "Discriminate against a firearm entity or firearm trade association" does not include: (1) the established policies of a merchant, retail seller, or platform that restrict or prohibit the listing or selling of ammunition, firearms, or firearm accessories; (2) a company's refusal to engage in the trade of any goods or services, decision to refrain from continuing an existing business relationship, or decision to terminate an existing business relationship to comply with federal, state, or local law, policy, or regulations or a directive by a regulatory agency, or for any traditional business reason that is specific to the customer or potential customer and not based solely on an entity 's or association's status as a firearm entity or firearm trade association.

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

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: TX20210008 01/01/2021

Superseded General Decision Number: TX20200008

State: Texas

Construction Type: Highway

Counties: Brewster, Crockett, Culberson, Edwards, Hudspeth, Jeff Davis, Kinney, Pecos, Presidio, Reeves, Sutton, Terrell and Val Verde 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

* SUTX2011-001 08/02/2011

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER (Paving, Structure)	$ 12.77	
FORM BUILDER/FORM SETTER (Structures)	$ 12.38	

LABORERS
Asphalt Raker.....$ 11.64
Common Laborer.....$ 10.24
Flagger.....$ 8.70
Utility Laborer.....$ 12.11
Work Zone Barricade Servicer.....$ 10.77

POWER EQUIPMENT OPERATOR:
Asphalt Distributor.....$ 15.72
Asphalt Paving Machine.....$ 14.20
Broom or Sweeper.....$ 11.62
Excavator 50,000 lbs. or less.....$ 14.38
Front End Loader 3 cu yd or less.....$ 13.15
Front End Loader over 3 cu yd.....$ 12.86
Motor Grader , Fine.....$ 16.69
Motor Grader, Rough.....$ 18.50
Pavement Marking Machine....$ 12.01
Roller, Asphalt.....$ 11.61
Roller, Other.....$ 11.64

Servicer.....$ 15.56

TRUCK DRIVER
Single Axle.....$ 13.53
Tandem Axle Tractor with Semi Trailer.....$ 13.16

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: TX20210199 07/09/2021

Superseded General Decision Number: TX20200199

State: Texas

Construction Type: Building

Counties: Edwards, Presidio and Reagan Counties 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
2	07/02/2021
3	07/09/2021

ASBE0066-009 03/01/2014

Reagan County

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 20.79	11.12

ASBE0076-004 01/01/2021

Presidio County

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 25.71	11.78

ASBE0087-012 03/02/2020

Edwards County

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 23.97	10.79

BOIL0074-010 01/01/2017

Edwards County

	Rates	Fringes
Boilermaker	$ 28.00	22.35

BOIL0531-007 01/01/2017

Presidio and Reagan Counties

	Rates	Fringes
Boilermaker	$ 28.00	22.35

IRON0066-011 06/01/2020

Edwards County

	Rates	Fringes
IRONWORKER, REINFORCING AND STRUCTURAL	$ 23.45	6.83

IRON0263-026 06/01/2020

Presidio and Reagan Counties

	Rates	Fringes
Ironworker, reinforcing and structural	$ 25.14	7.43

LABO0154-006 05/01/2008

Edwards County

	Rates	Fringes
Laborers: (Mason Tender - Cement/Concrete)	$ 12.98	3.49

LABO0154-014 05/01/2008

Presidio and Regan County

	Rates	Fringes
Laborers: (Mason Tender - Cement/Concrete)	$ 12.73	3.20

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* PLUM0142-007 07/01/2021

Edwards County

	Rates	Fringes
Plumber	$ 32.60	12.50

PLUM0404-001 09/01/2020

	Rates	Fringes
PLUMBER	$ 26.05	8.81

PLUM0412-010 04/01/2013

Presidio County

	Rates	Fringes
PLUMBER	$ 31.14	12.43

SUTX2009-086 04/20/2009

	Rates	Fringes
ACOUSTICAL CEILING MECHANIC	$ 14.50	0.00
BRICKLAYER	$ 17.76	0.00
CARPENTER, Includes Drywall Hanging (Excludes Acoustical Ceiling Installation)	$ 13.46	0.00
CEMENT MASON/CONCRETE FINISHER	$ 13.27	0.00
ELECTRICIAN	$ 15.85	0.00
LABORER: Common or General	$ 8.72	0.00
LABORER: Landscape & Irrigation	$ 8.50	0.22
LABORER: Mason Tender - Brick	$ 12.02	0.00
LABORER: Mortar Mixer	$ 9.50	0.00
LATHER	$ 12.00	0.00
OPERATOR: Backhoe/Excavator/Trackhoe	$ 13.75	0.00
OPERATOR: Bulldozer	$ 12.80	0.43
OPERATOR: Crane	$ 21.33	0.00
OPERATOR: Forklift	$ 14.58	0.00
OPERATOR: Loader (Front End)	$ 10.54	0.00
PAINTER: Brush, Roller and Spray	$ 15.80	0.00
PLASTERER	$ 12.00	0.00
ROOFER	$ 15.10	1.29
SHEET METAL WORKER, Includes HVAC Duct Installation	$ 18.00	0.00

TILE SETTER.....$ 15.00 0.00

TRUCK DRIVER.....$ 11.24 0.35

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)).

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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

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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

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.

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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:

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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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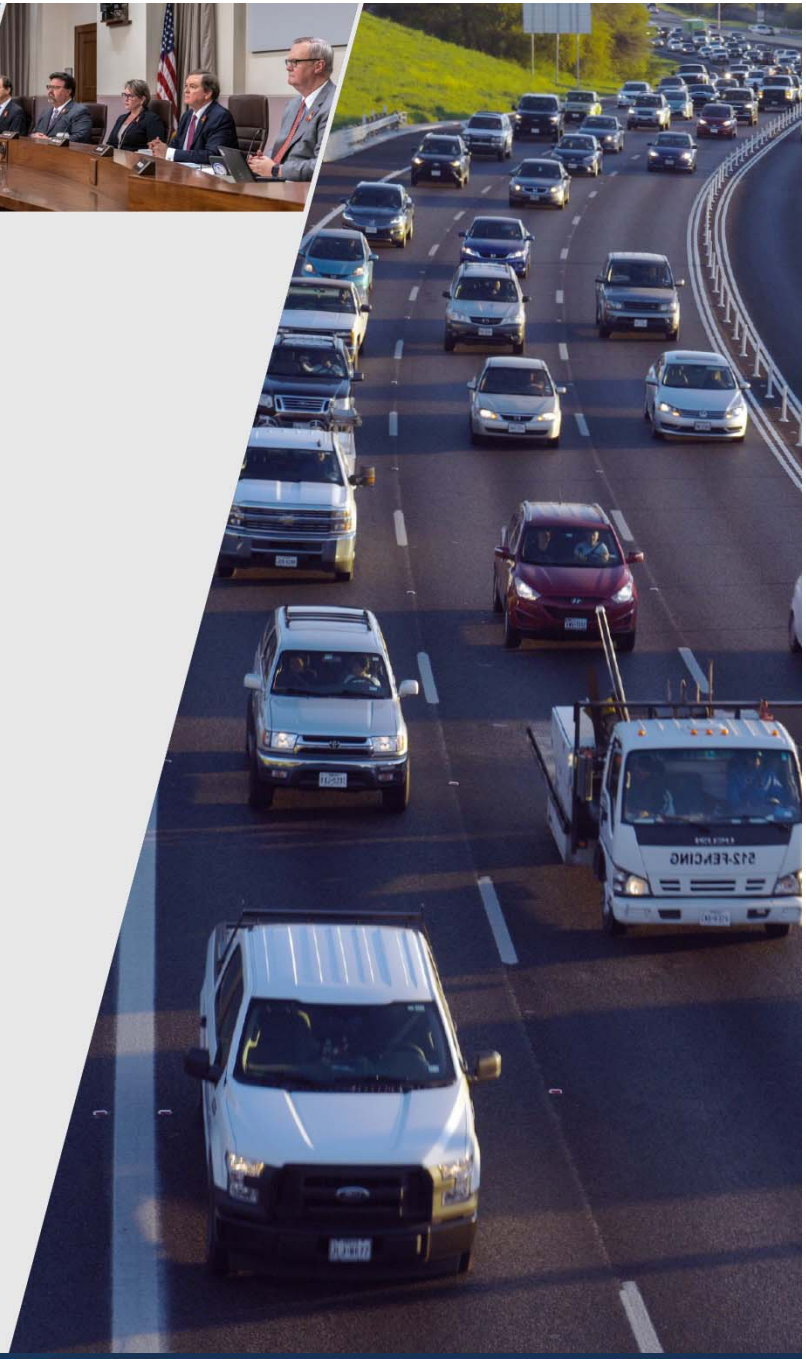
END OF GENERAL DECISION"

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!!

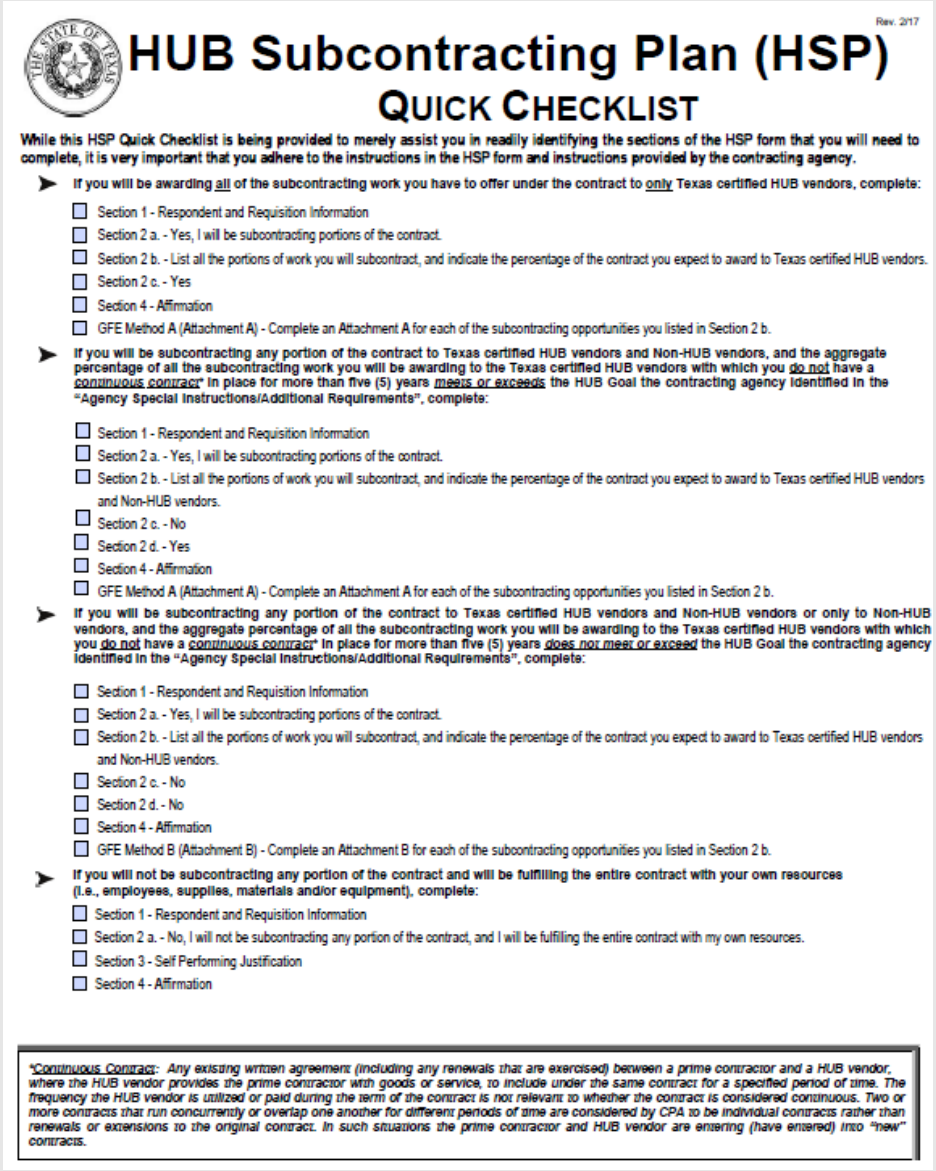
For the most current version, go to:

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.

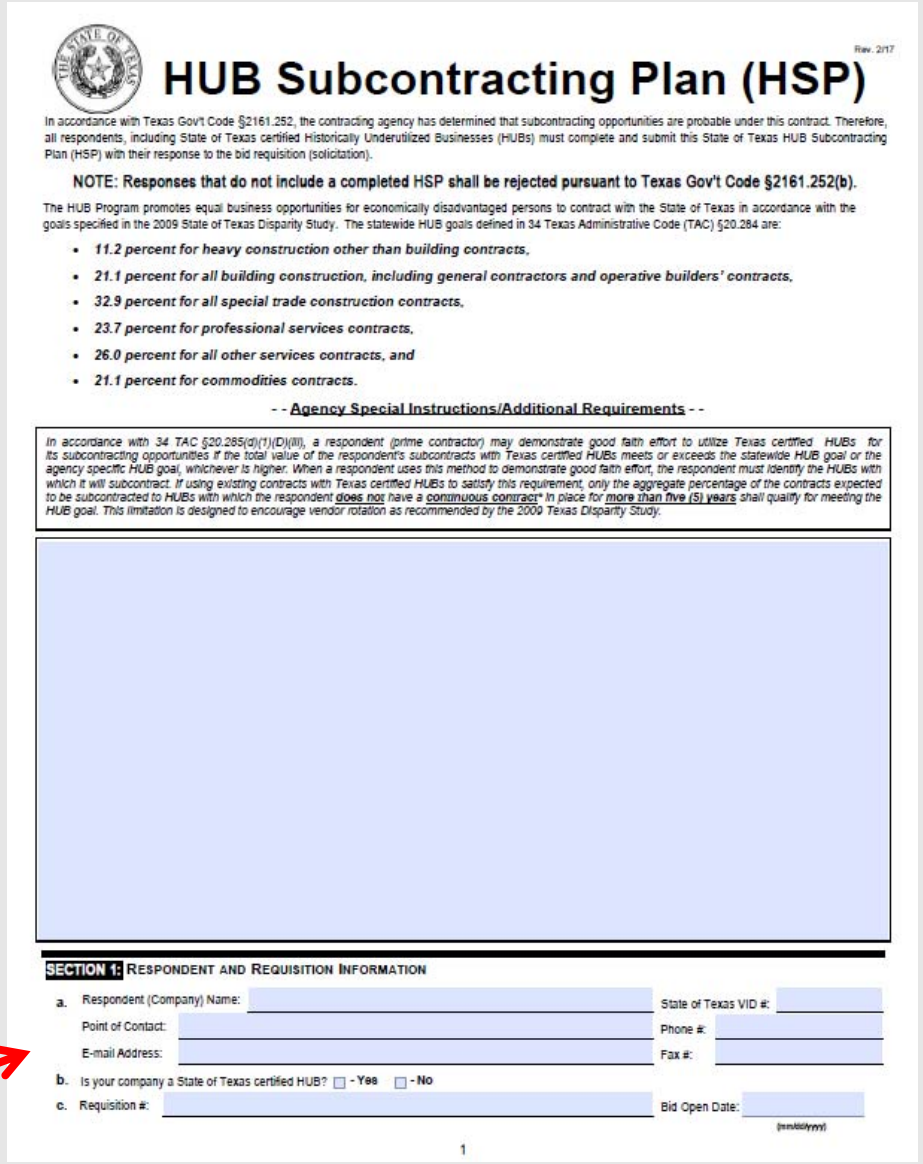
HSP Completion: Option 1 – Using Only HUBs

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

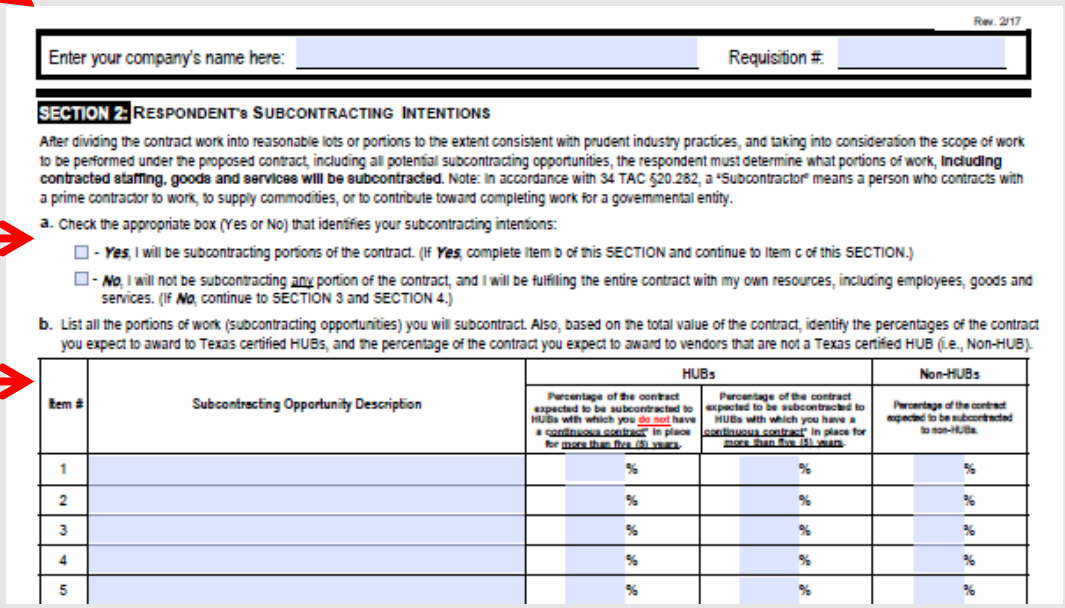
Page 2

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).

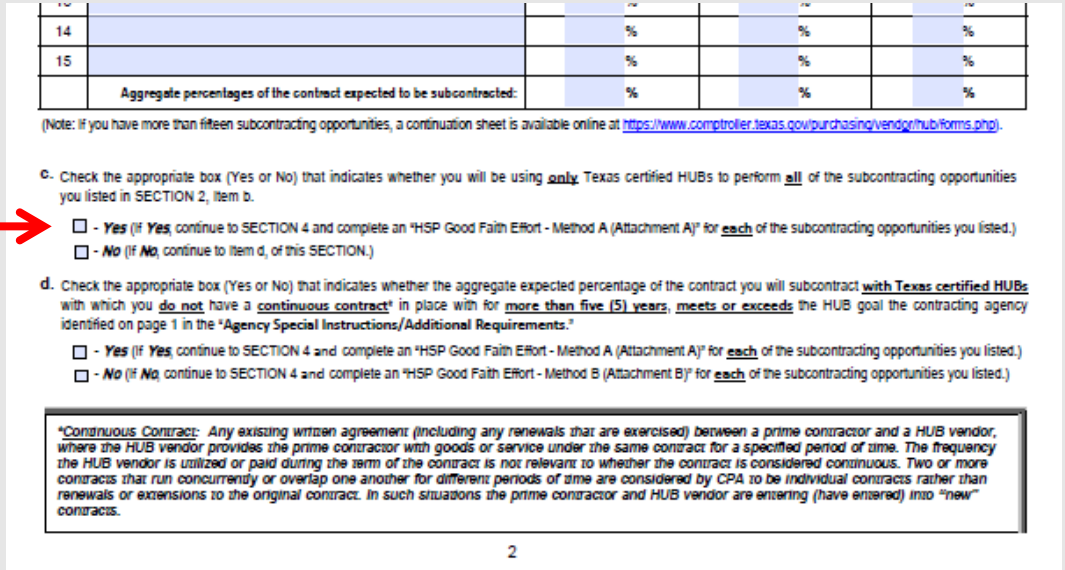
Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a "continuous contract" in place for more than five (5) years.	Percentage of the contract expected to be subcontracted to HUBs with which you have 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.

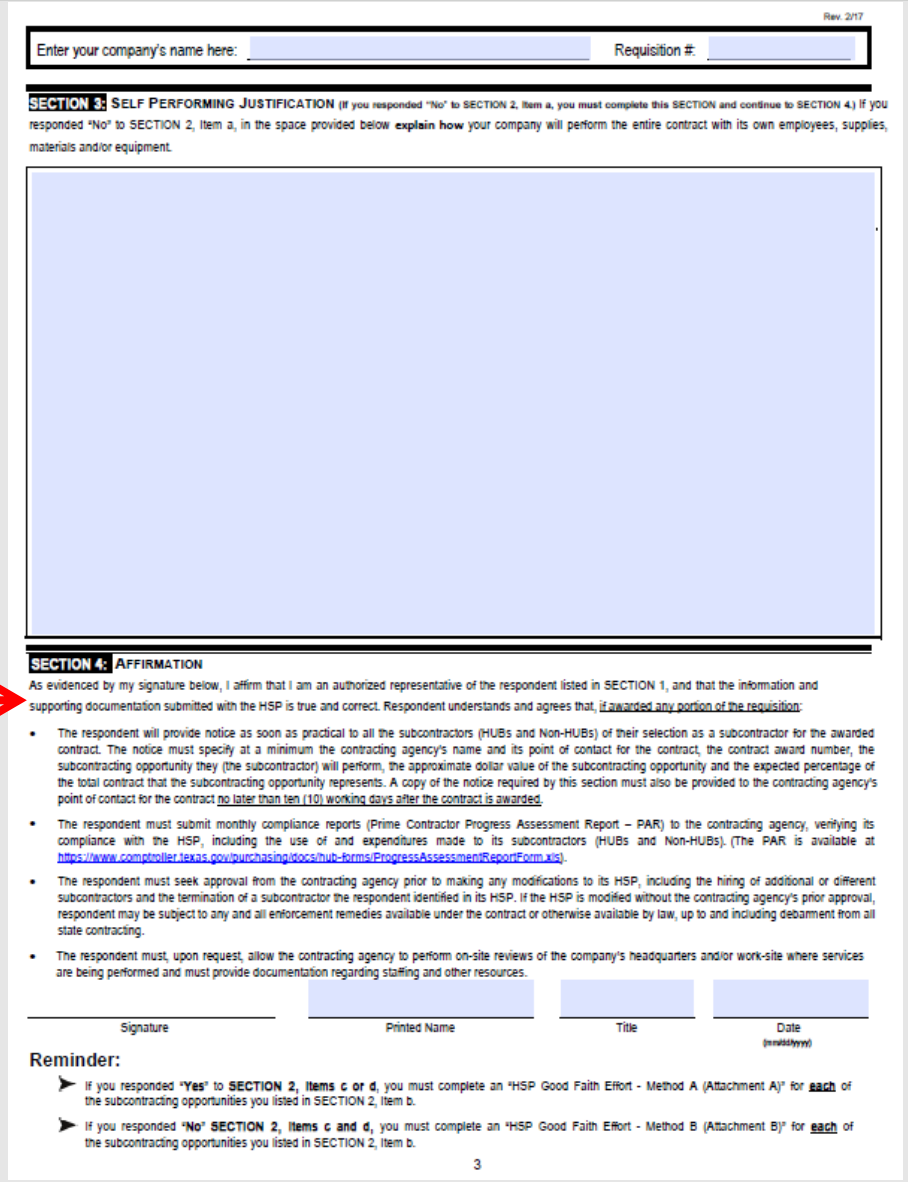
HSP Completion: Option 1 – Using Only HUBs

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		$	%
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	☐ - 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)

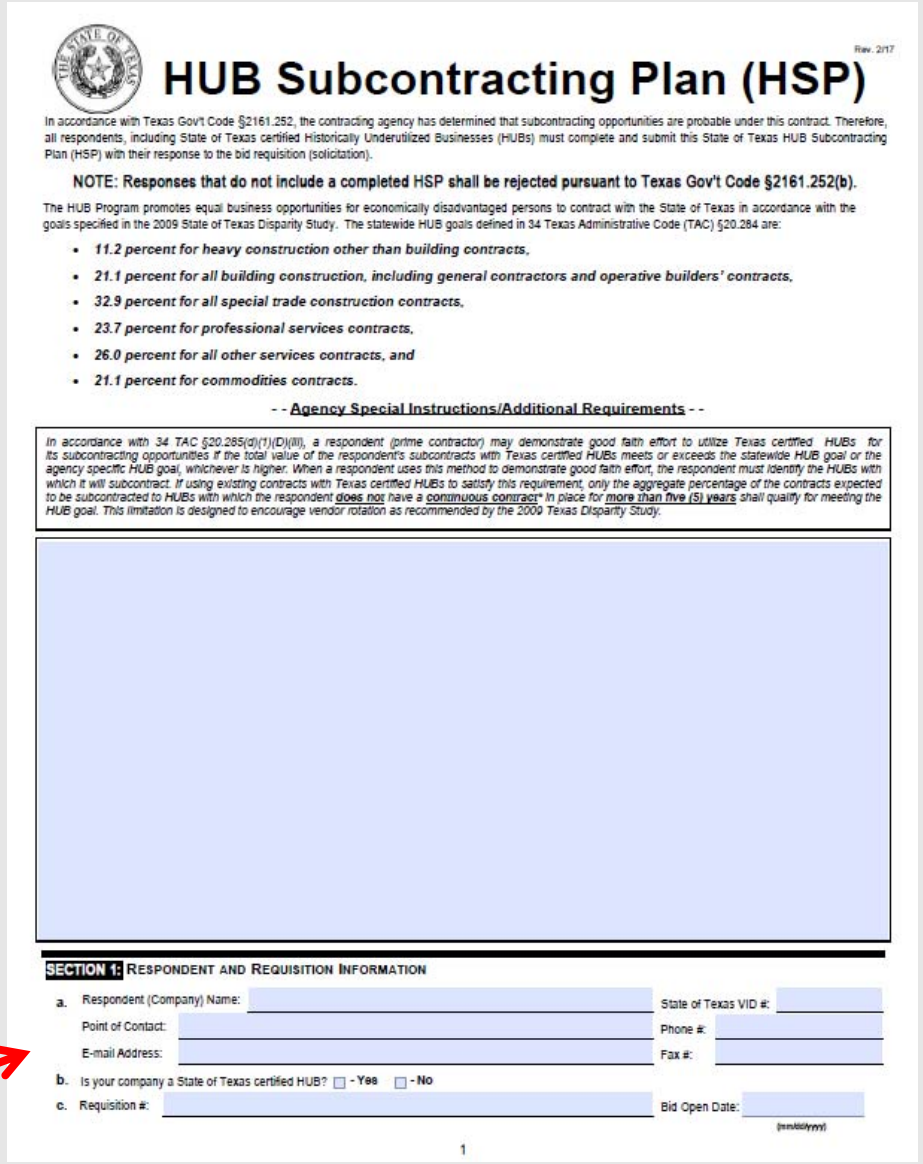
HSP Completion: Option 2 – Meeting TxDOT's HUB Goal

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

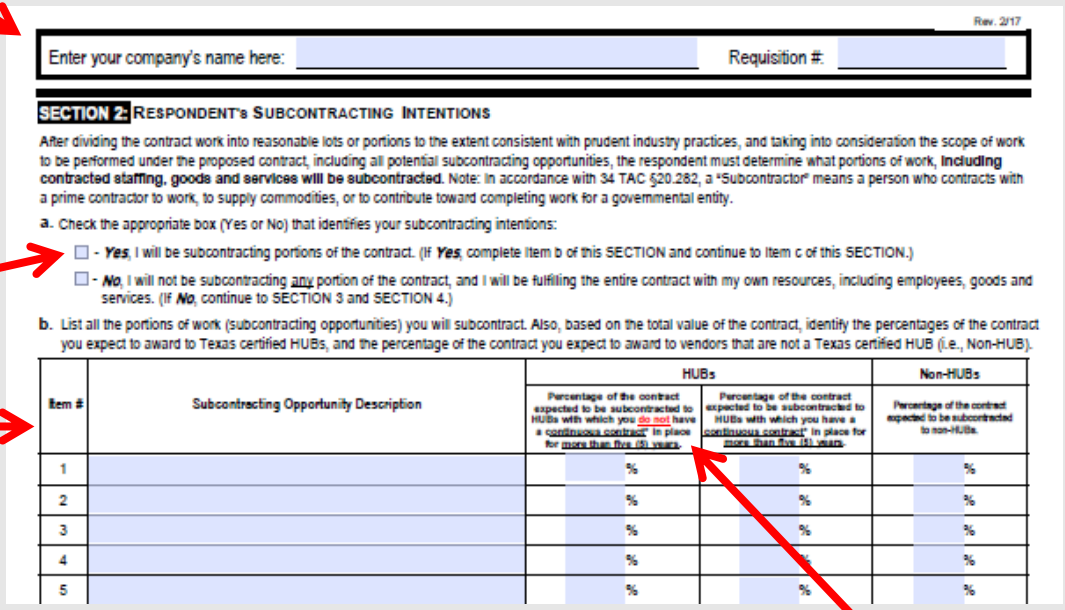
Page 2

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**.

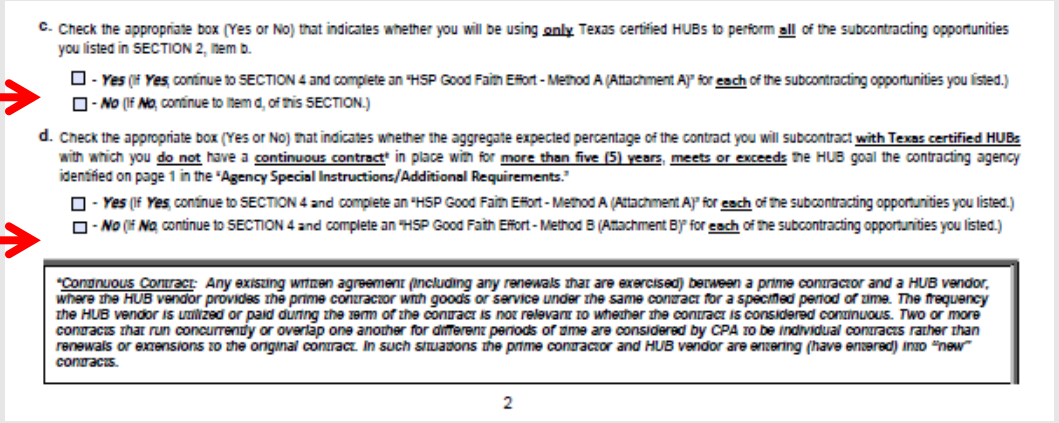
HSP Completion: Option 2 – Meeting TxDOT's HUB Goal

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

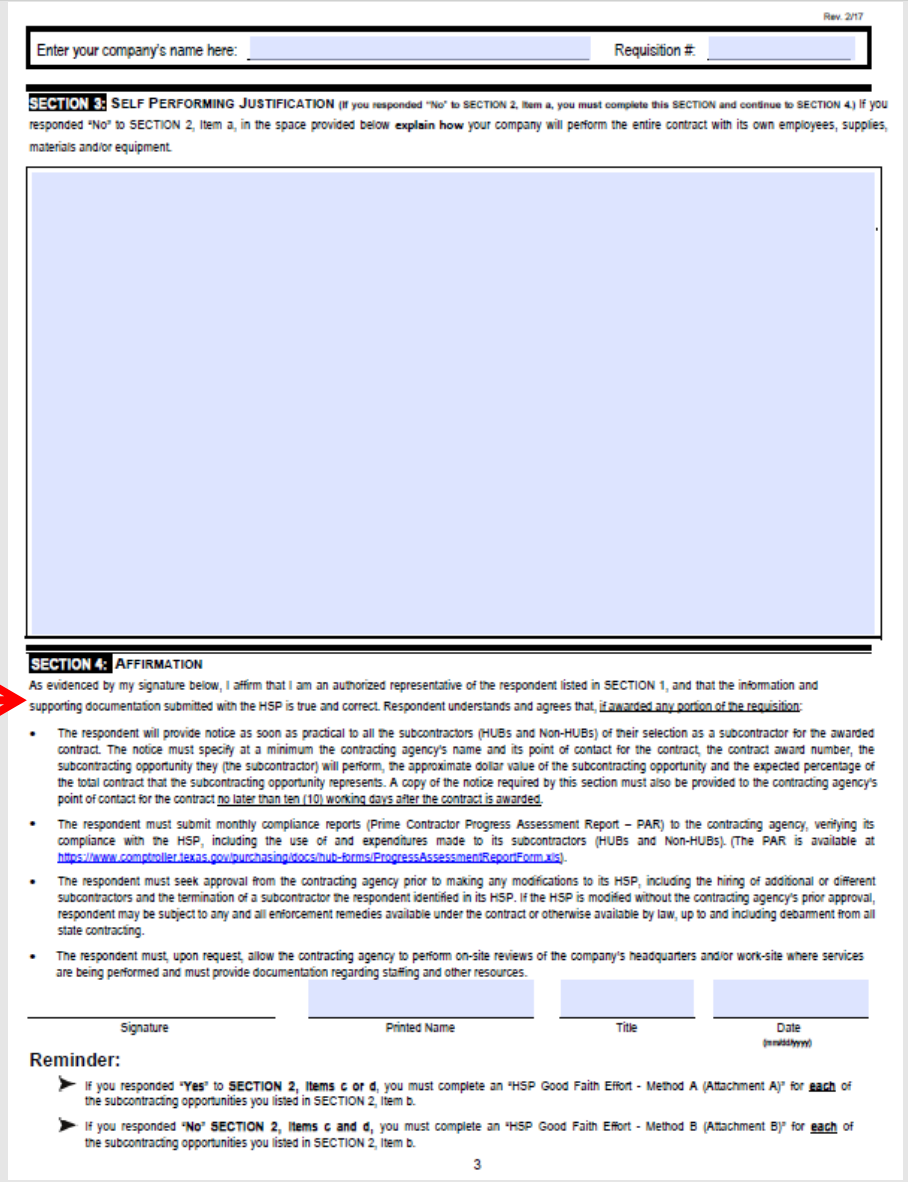
HSP Completion: Option 2 – Meeting TxDOT's HUB Goal

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.

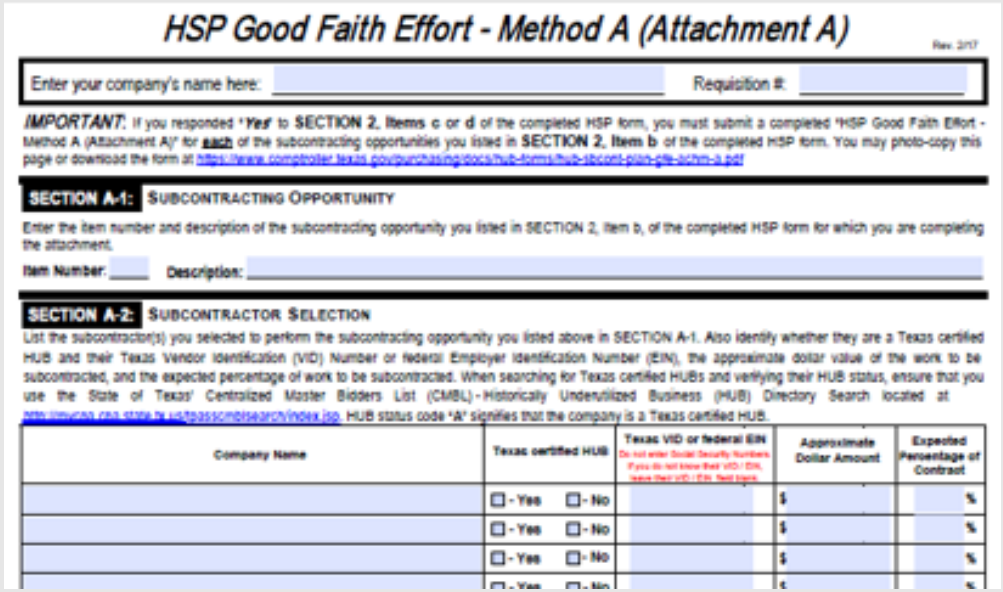
Section A-1:

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)

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://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		$	%

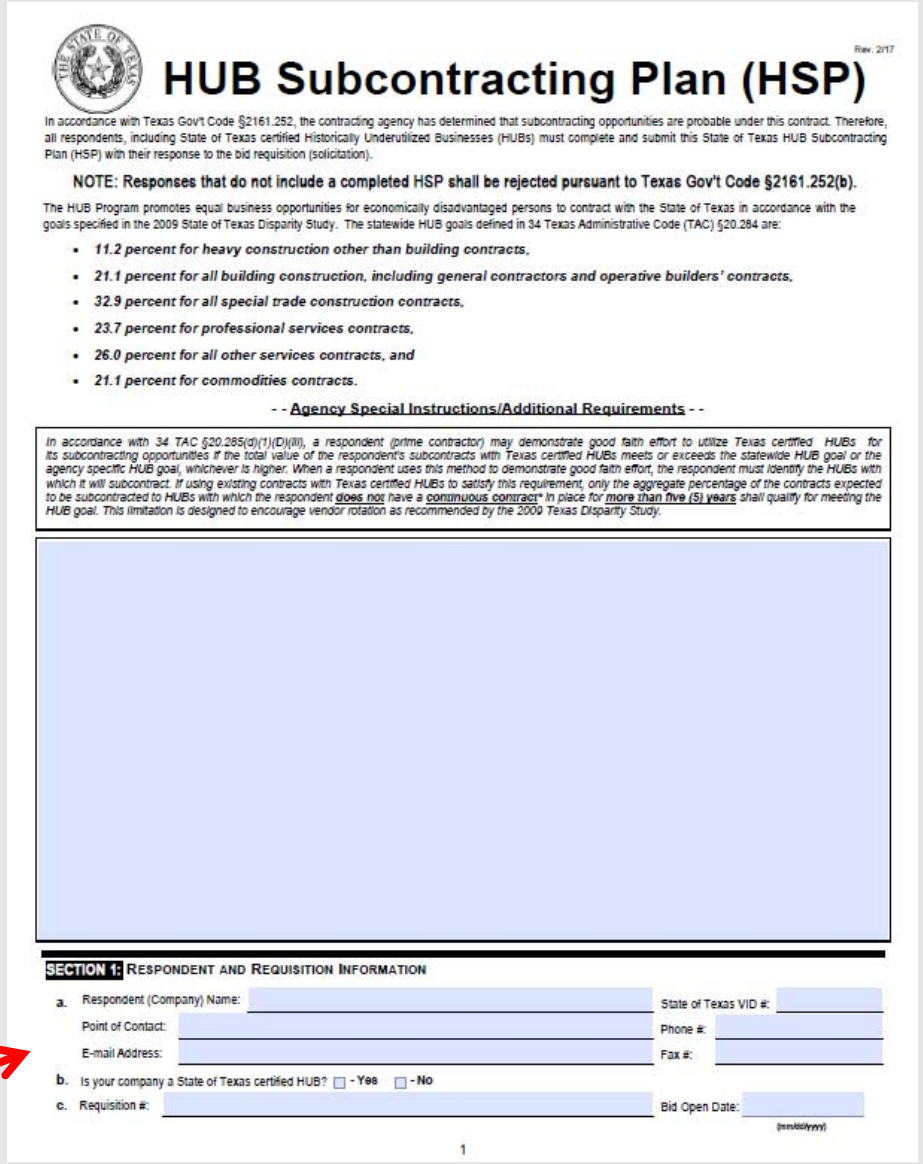
HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

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

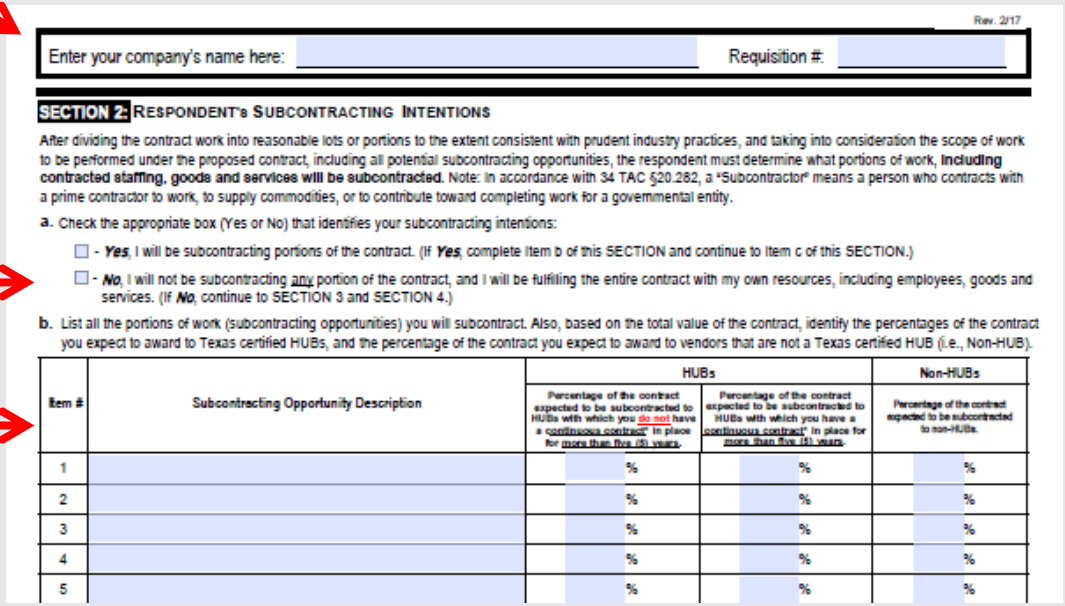
Page 2

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		%	%	%

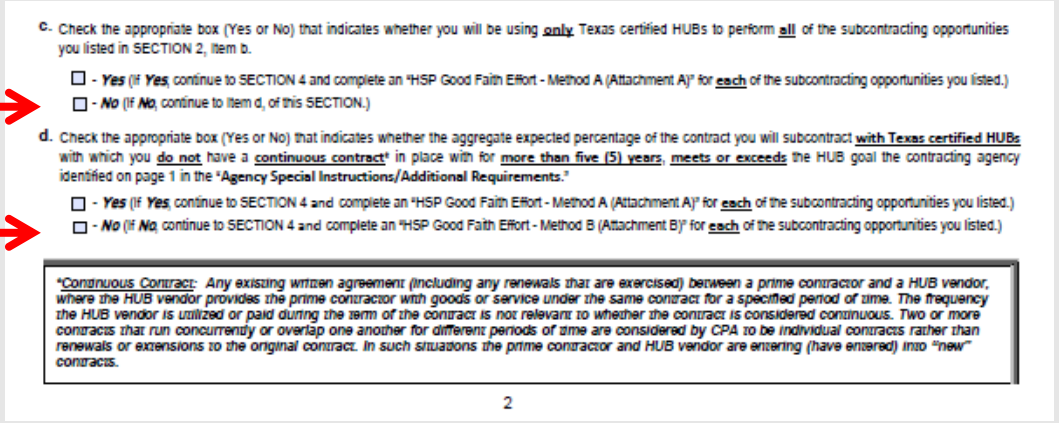
HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

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

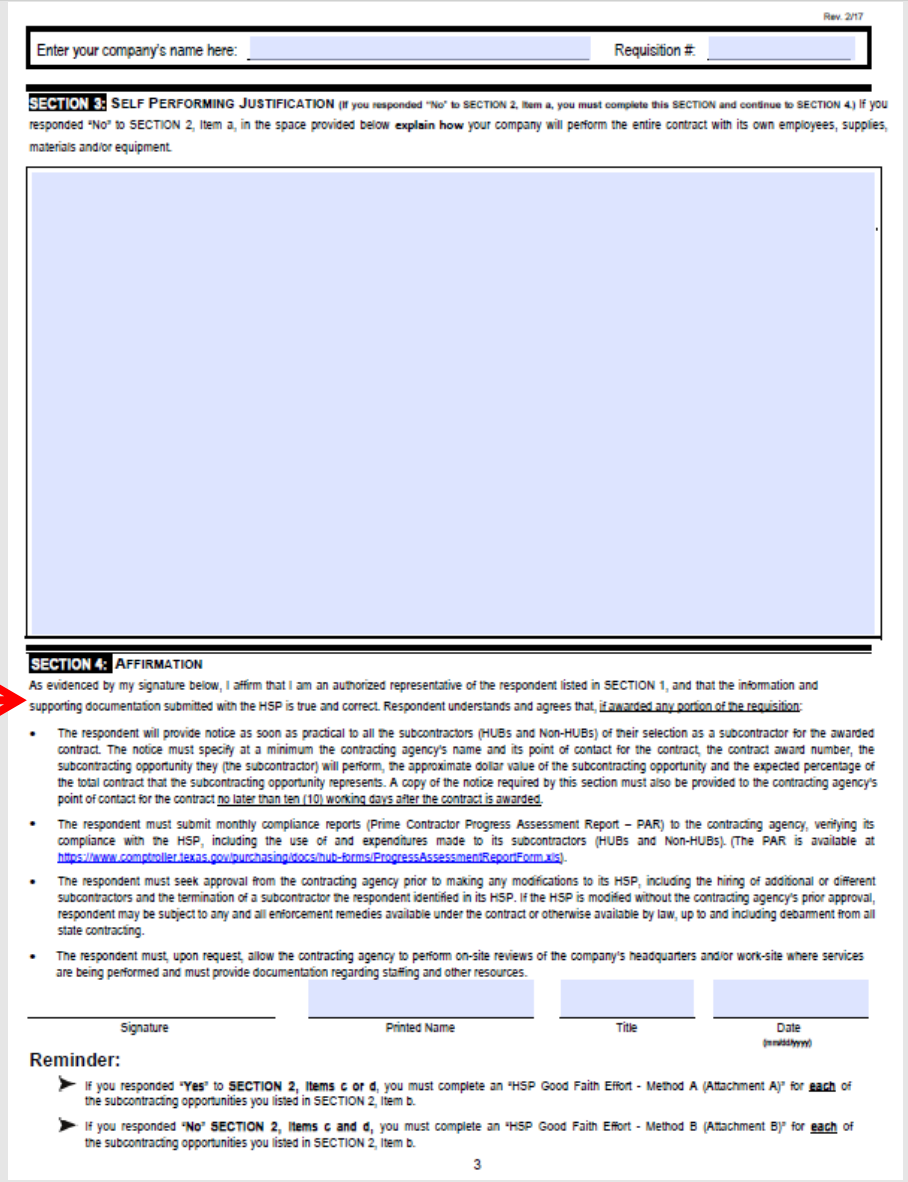
HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

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.

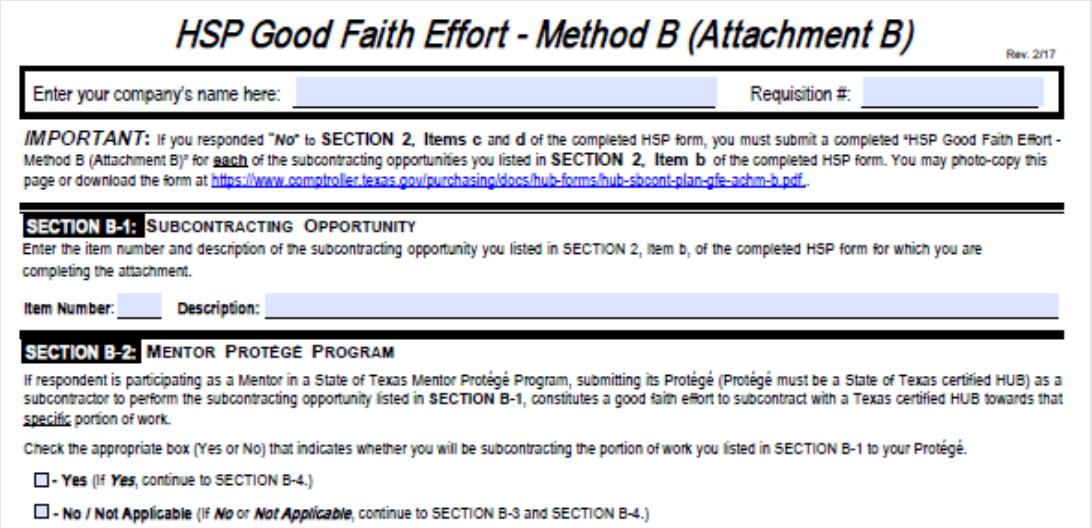
Section B-1:

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

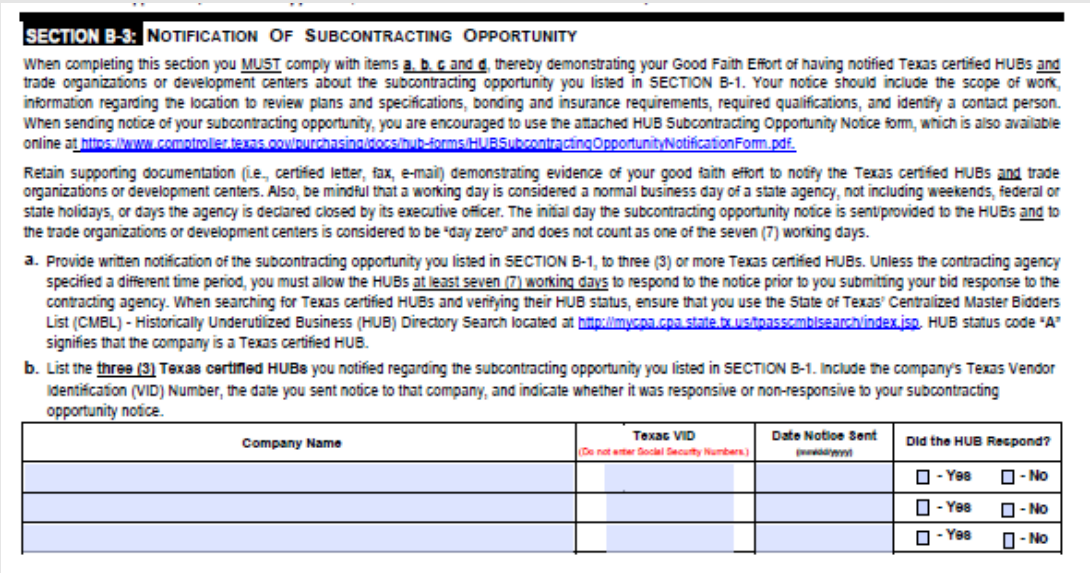
Section B-3:

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

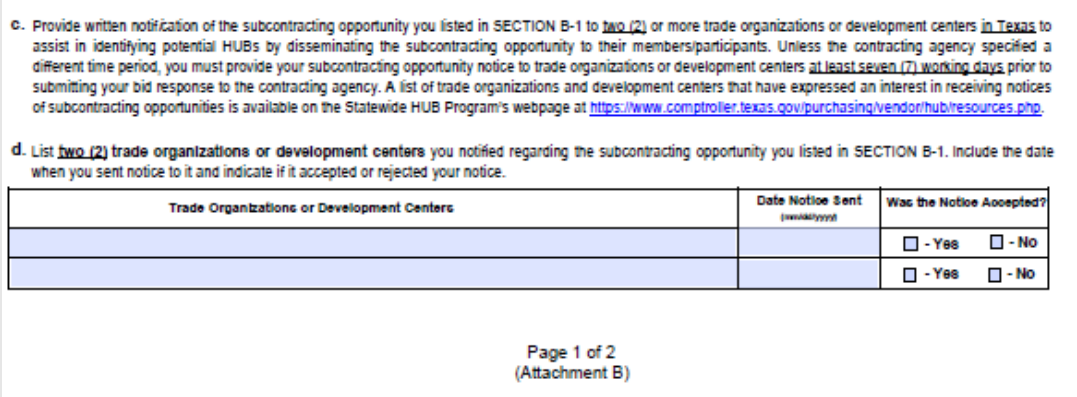
HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

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

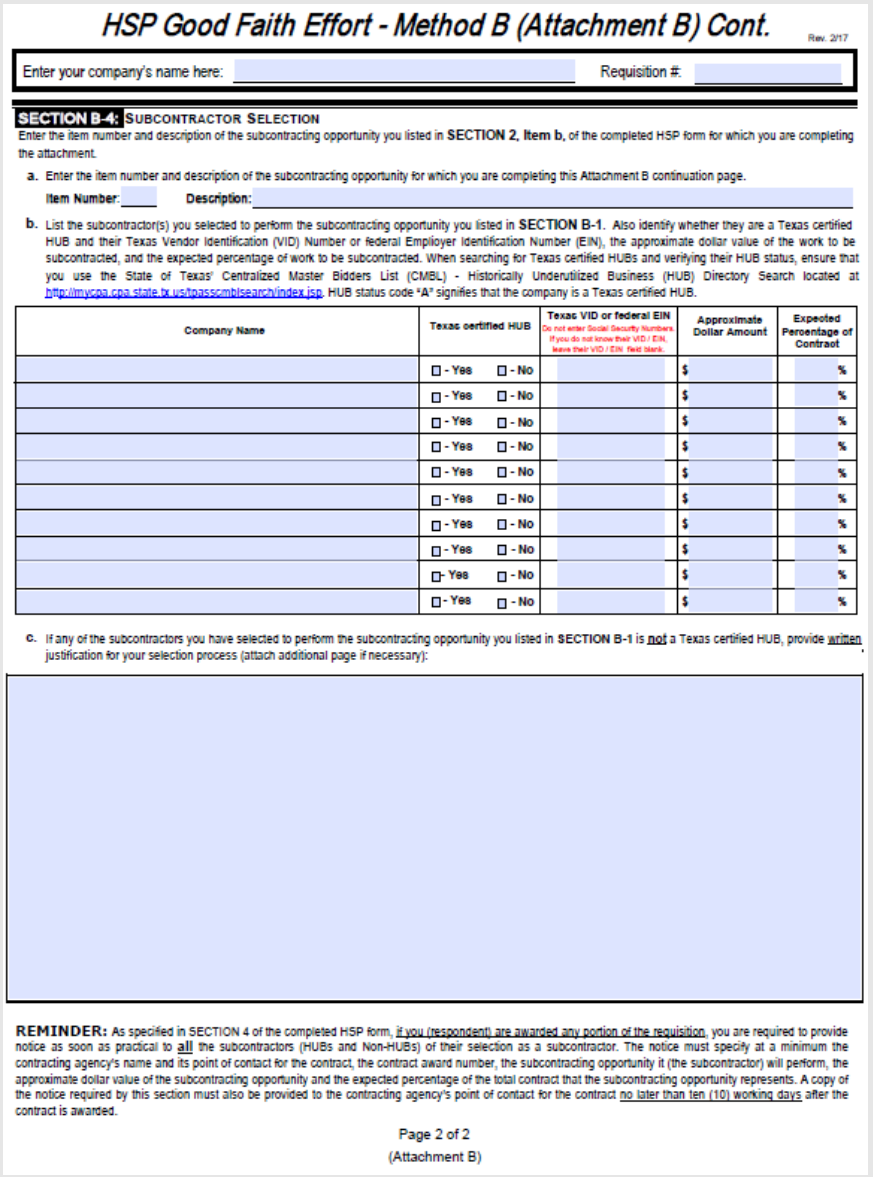
HSP Good Faith Effort – Method B (Attachment B) Page 2

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)

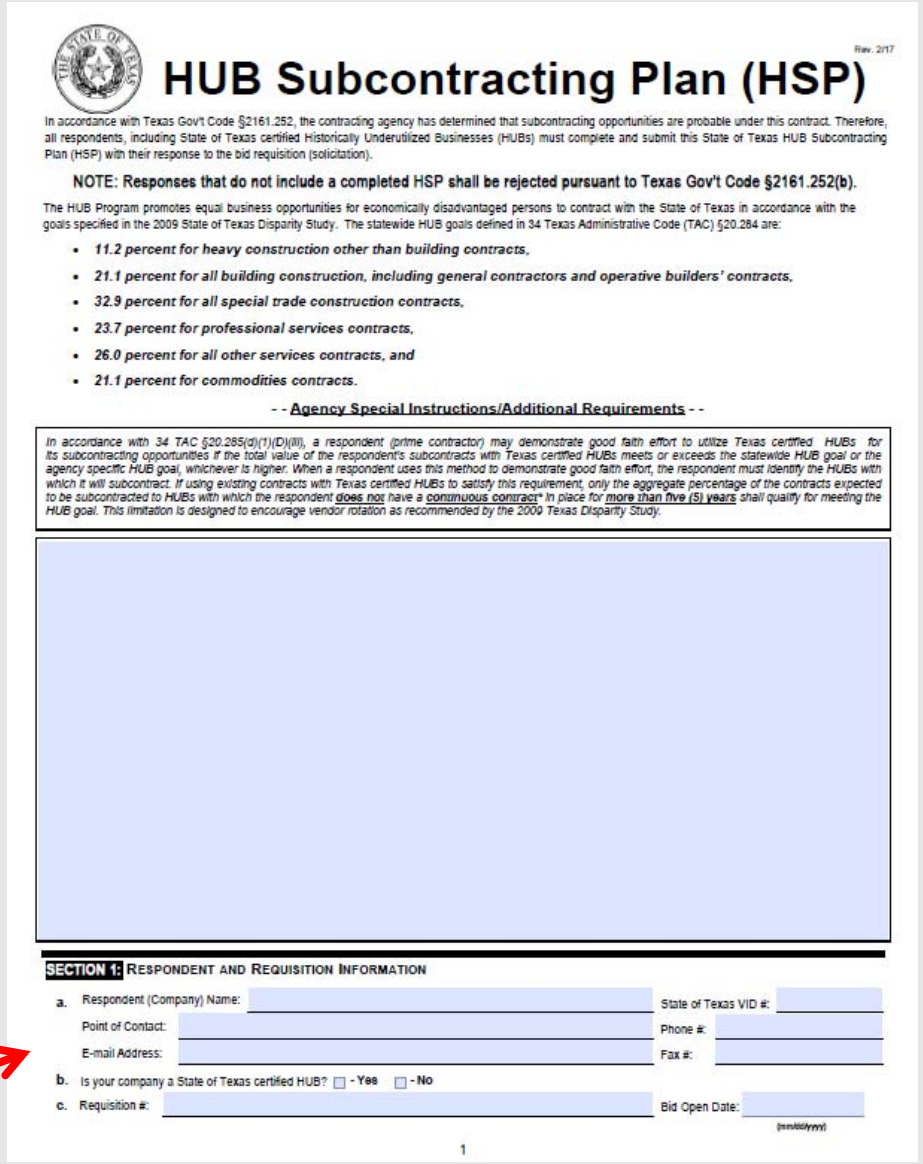
HSP Completion: Option 4 – Self-Performing

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

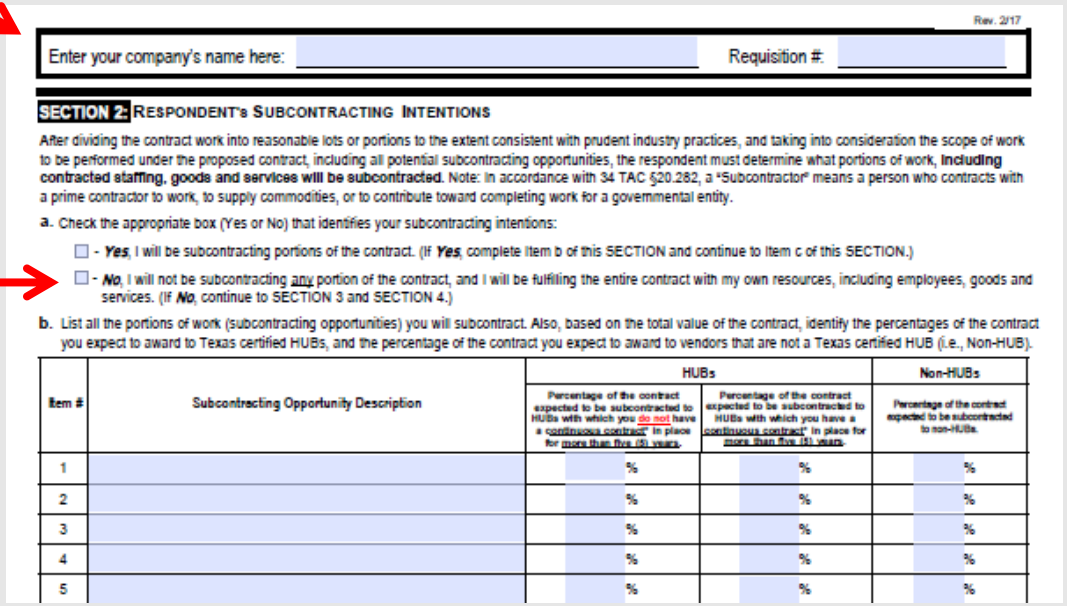
Page 2

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

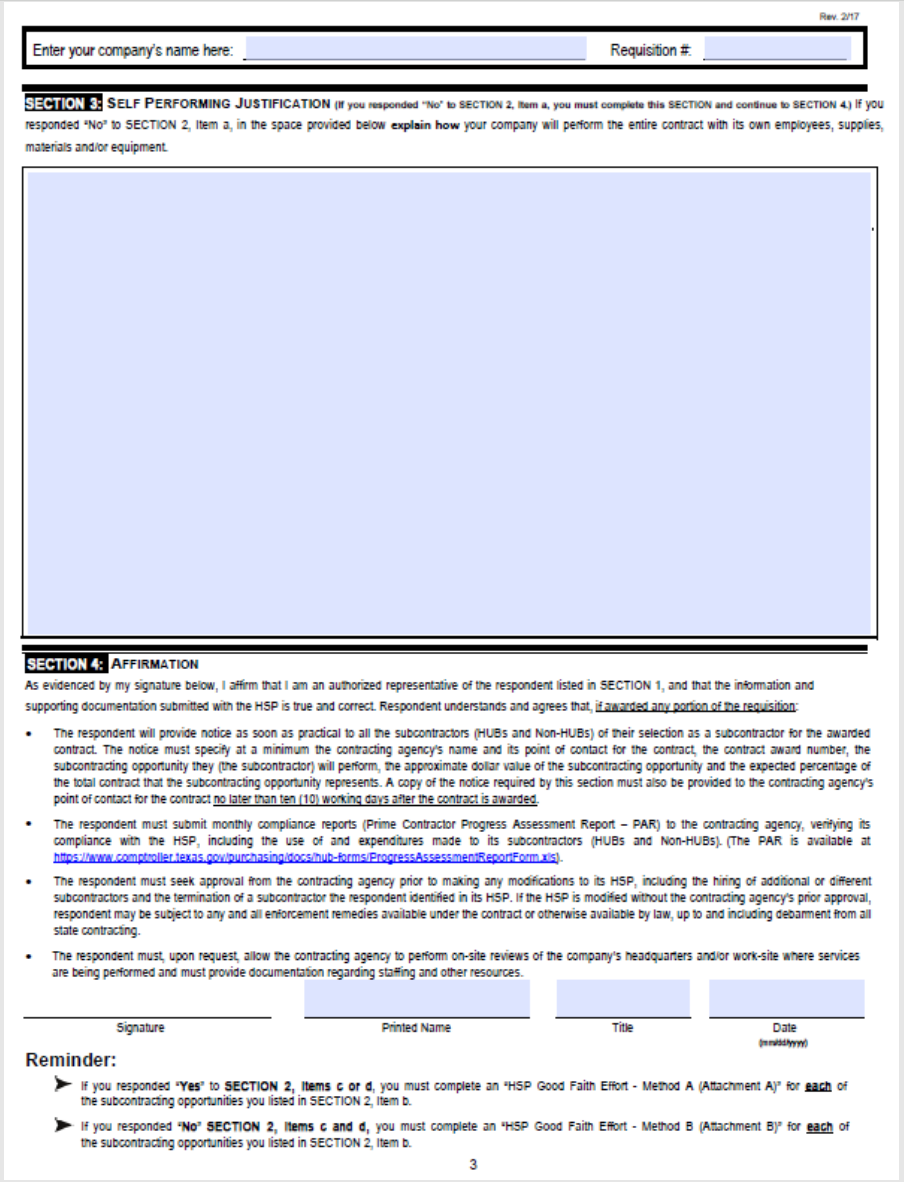
Page 3

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

SECTION 01 00 70

PROVISIONS FOR ACCESSIBILITY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section is fashioned to express an overview of the subject matter of the Texas Accessibility Standards (TAS). This Section 01 00 70 is not the Texas Accessibility Standards.
B. Go to the following link for the Standards:
   1. www.tdlr.texas.gov/ab/abtas.htm

1.2 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 10 00 - Summary
C. Section 01 11 13 - Work Covered by Contract Documents

1.3 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
   1. Standards for Accessible Design of Americans with Disabilities Act (ADA) adopted by the U. S. Department of Justice in September, 2010.
B. TAS - 2012 Texas Accessibility Standards (TAS) 2012.
   1. The TAS covers scoping and technical requirements for accessibility to sites, facilities, buildings, and elements by individuals with disabilities in the state of Texas.
   2. Requirements of the 2012 Texas Accessibility Standards (TAS) adopted on November 1, 2011, for the purpose of administering the Architectural Barriers Act, Article 469, Texas Civil Statutes, effective March 15, 2012.

1.4 GENERAL REQUIREMENTS:

A. Provisions for accessibility shall be made in full compliance with the 2010 Standards for Accessible Design of Americans with Disabilities Act (ADA Standards) adopted by the U. S. Department of Justice in September, 2010, AND with the requirements of the 2012 Texas Accessibility Standards (TAS) adopted on November 1, 2011, for the purpose of administering the Architectural Barriers Act, Article 469, Texas Civil Statutes, effective March 15, 2012.
   1. The TAS covers scoping and technical requirements for accessibility to sites, facilities, buildings, and elements by individuals with disabilities in the state of Texas.
   2. Texas Department of Licensing and Regulation (TDLR) information - go to this link: www.tdlr.texas.gov/ab/abtas.htm.
B. Provisions for accessibility are indicated throughout the new construction, but not limited to, toilet stalls, urinals, lavatories, mirrors, and all other accessories in multiple-fixture toilet rooms, and including drinking fountains and other building appurtenances.
C. The information on the pages of this specification section is not represented as documents of or from the accessibility regulations. These data depict an interpretation of the regulations when

these sheets were created and/or edited. The contractors involved in the construction of this project are required to verify current requirements in force at the time this project is under construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 ACCESSIBILITY STANDARDS

A. The following is a partial listing of the accessibility standards which are included in The Requirements.
   1. These data depict an interpretation of the regulations when these sheets were created and/or edited. The contractors involved in the construction of this project are required to verify current requirements in force at the time this project is under construction.

B. In the event of a discrepancy between any dimensions on the drawings and any dimensions listed herein, the dimensions listed herein shall take precedence. The Contractor shall consult with the Architect upon discovery of any such discrepancy and corrections shall be made at the expense of the Contractor, with no additional cost to the Owner. Except in the event of such a discrepancy, all items shall be installed at the mounting heights indicated on the drawings.

C. Several of the Mounting Heights listed below address the mounting height requirements for children. Disregard heights listed for children at non-elementary/middle school buildings and non-children specific buildings.

3.2 MOUNTING HEIGHTS:

A. Handrails:
   1. Ramps:
      a. Standard: 34" - 38" above ramp.
   2. Stairs:
      a. Standard: 34" - 38" above nosings.

B. Drinking Fountains:
   1. Standing height: 27" min. knee space / 38” to 43” maximum to spout.
   2. Wheelchair height: 27" min. knee space / 36" maximum to spout.

C. Hand Dryers and Paper Towel Dispensers:
   1. 15” minimum.
   2. 48" maximum to control over a maximum 10” projection.
   3. 44” maximum to control over a 20” to 25” projection.

D. Water Closets:
   1. Children: 11" - 17" to top of seat.
   2. Standard: 17" - 19" to top of seat.
   3. NOTE: Flush valve handle must be on open side of stall/room.

E. Urinals:
   1. 17" maximum to basin opening.

F. Flush Controls: Water Closets
   1. 36" maximum to control.

G. Flush Controls: Urinals:

1. 44" maximum to control.

H. Grab Bars:
   1. Standard: 33" - 36" to top of bar.
   2. Toilet Partition Height:
      a. Standard: 9” minimum to bottom.

I. Lavatories and Sinks:
   1. Standard: 27" min. knee clearance at apron / 34" maximum to top.

J. Mirrors:
   1. Above a countertop: 40" maximum to bottom of the reflective surface. (Not to the frame bottom.)
   2. Not above a countertop: 35" maximum to bottom of the reflective surface. (Not to the frame bottom.)

K. Toilet Paper Dispenser: 15" minimum to 48” maximum to dispenser outlet.
   1. Locate 8 inches horizontally from front edge of water closet to center line of dispenser.

L. Telephones:
   1. Frontal Approach:
      a. 48" max. to top device.
      b. With TTY device: 34” minimum to keypad.

M. Electrical and Communication Systems Receptacles:
   1. 48" maximum / 15" minimum.

N. Switches, Controls and Alarms:
   1. 48" maximum / 15" minimum.

O. Audio-Visual Fire Alarm Signal: Comply with NFPA-72, 1999 or later.

P. Room Identification Signage: 48” minimum to 60” maximum to base line of tactile characters.

Q. Parking Identification Signage: Graphic symbols 60" minimum above paving.

R. Door Handles, Pulls, Locks, Etc.:
   1. Standard: 34” minimum / 48" maximum.
   2. Swimming pool/spa/hot tub security gates: 34” minimum / 54” maximum.

S. Door Operating Force:
   1. Interior Hinged Doors: 5 pounds of force, maximum.
   2. Sliding or Folding Doors: 5 pounds of force, maximum.

T. Door Threshold:
   1. Height at new doors: 1/2" maximum.
   2. Height at existing or altered doors: 3/4” maximum, with bevel on each side with 1:2 maximum slope.

U. Protruding Objects:
   1. Wall mounted:
      a. 27" - 80" High to bottom; 4" maximum projection
   2. Wall mounted:
      a. Less than 27" High to bottom; No maximum projection.
   3. Post or Pylon mounted:
      a. 27"-80" High to bottom; 12" maximum projection.
   4. Post mounted:
      a. 2 posts, greater than 12" apart; 27" maximum clearance below.

5. Ceiling mounted:
    a. 80" minimum clearance.

V. Passenger Elevators:
1. Hall Call Buttons: 48" maximum to center.
2. Car Control Buttons:
    a. Standard: 15" maximum / 48” maximum.
    b. Children: 20" minimum / 44” maximum.
3. Hall Lanterns: 72" minimum.
4. Raised Floor Designations on Jambs: 48” minimum / 60" maximum to bottom of characters.
5. Obstruction Sensors: 5" - 29" high.
6. Emergency car controls: 35" minimum to center.
7. Emergency Communications Devices:
    a. Standard: 15” minimum / 48" maximum.

W. Platform Lifts:
1. Controls: 15" minimum - 48" maximum above platform.

X. Dining Tables and Work Surfaces:
1. Standard: 27" minimum knee clearance;
    a. 28" minimum - 34" maximum to top.

Y. Bathrooms, Bathing Facilities, and Showers:
1. Bathtubs:
    a. Seat: 17” minimum / 19” maximum to bathroom floor.
    b. Grab Bars: two bars, 8” minimum / 10” maximum above tub, and 33” minimum / 36” maximum above tub.
2. Shower Stalls:
    a. Seat: 17” minimum / 19” maximum high.
    b. Grab Bars:
        1) Standard: 33" minimum / 36" maximum above stall floor.
    c. Controls:
        1) Standard: 15” minimum / 48" maximum.

Z. Restaurants and Cafeterias:
1. Service Counter: 36” maximum.
2. Tray Slide: 28” minimum / 34” maximum.
3. Self-Serve Shelves with maximum height of 48".
    a. Minimum 50% of all shelves.
4. Dining Surfaces:
    a. Standard: 28” minimum / 34” maximum.

AA. Business and Mercantile:
1. Sales Counters: 36" maximum.
    a. (x 36" min. length)
2. Dressing Room Benches: 17" - 19" above floor.

3.3 SLOPES ALONG ROUTES ACCESSIBLE BY THE HANDICAPPED:

A. Walkways:

1. Cross Slope: 1:48 maximum.
2. Running Slope: 1:20 (5.0%) maximum.

B. Landings:
1. Cross Slope: 1:48 maximum.
   a. (Measured in any direction)
2. Running Slope: Level.

C. Ramps:
1. Cross Slope: 1:48 maximum.
2. Running Slope:
   a. 3" Rise (existing facilities only) 1:8 (12.5%) maximum.
   b. 6" Rise (existing facilities only) 1:10 (10.0%) maximum.
   c. All new construction 1:12 (8.3%) maximum.
3. Rise 30" maximum.
4. Width: 36” minimum clear between handrails.

D. Floor Level Changes:
1. Without Edge Treatment: 1/4" maximum.
2. With Edge Treatment: 1:2 Maximum Slope, 1/2" maximum rise.

E. Carpet Pile Height: 1/2" maximum.

END OF SECTION

SECTION 01 10 00

SUMMARY

PART 1 - GENERAL

1.1 PROJECT IDENTIFICATION

TEXAS DEPARTMENT OF TRANSPORTATION
EL PASO DISTRICT - 24, PRESIDIO COUNTY
Presidio Maintenance Facility
16365 FM 170
Presidio, TX 79845

1.2 CONTRACT DESCRIPTION

A. Work of this project includes construction of a new office / maintenance facility building for TxDot located just outside of Presidio, Texas. This facility will be located on an 18.9-acre of undeveloped land, just north of the city of presidio along access of FM 170. The scope for this facility is to site adapt an existing TxDot prototype design that includes an approximately 12,500 square foot maintenance facility; exterior entry cover; 10,500 square feet of exterior open covered storage; 1,200 square foot salt storage structure; above ground fueling station; emulsion tank base structure along with relocation of the existing emulsion tank; future radio tower; and parking for all district and employee vehicles. Backup power is to be provided for this type of facility. The structure used for the maintenance building as well as 2 of the 3 additional accessory buildings will be a PEMB structure. The salt storage accessory building will be wood construction.

Construction can be generally described to include:

- Site work including utilities, drainage, driveways, & parking lots
- Relocation of an existing emulsion tank.
- Concrete slab on grade foundations with spread footings
- Masonry veneer on a portion of the main building with metal stud back-up and metal stud interior partitions
- Aluminum storefront windows and doors
- Hollow metal doors and frames, wood doors, door hardware
- Miscellaneous carpentry items, millwork, blocking and paneling
- Finishes including LVT flooring, acoustical ceiling, paint, tiling
- HVAC equipment and ducting
- Plumbing fixtures and associated domestic water and septic system
- Electrical light fixtures, power systems including panel boards, transformers, switches, and generators
- Fueling system for refueling of vehicles
- Technology cabling and terminations

B. Perform Work of Contract under Lump Sum Total cost contract with Owner in accordance with Conditions of Contract.

1.3 WORK BY OWNER

A. 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.

1.4 OWNER SUPPLIED PRODUCTS

A. Owner will provide all project information using BIM360 for all Construction Project Management activities. Owner will provide BIM360 licenses for the contractor to use during the Construction of the project from NTP through project closeout.

B. Owner will arrange for and deliver of Owner-furnished items unless noted otherwise.
   1. Contractor will arrange for and deliver the Owner-furnished emulsion tank.

C. Owner will arrange and pay for delivery of Owner-furnished items, unless noted otherwise, according to Contractor's Construction Schedule.
   1. Contractor will arrange and pay for delivery of the existing Owner-furnished emulsion tank. Contractor shall coordinate with the Owner regarding the schedule for cleaning out of this existing emulsion tank prior to relocation.

D. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.

E. 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.

F. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.

G. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

1.5 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.

1.6 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.'

1.7 CONTRACTOR

A. Owner's BIM360 platform will be utilized for Document Management, RFI's, Submittals, Project Management, field inspections, and punch list. Owner will provide BIM360 licenses for the Contractor to use. Contractor will maintain all project records utilizing the Owner's BIM360 platform.

B. 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.

C. Codes: Comply with applicable codes and regulations indicated on coversheet of Construction Drawings. Submit copies of inspection reports, notices and similar communications to Owner.

D. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. **Do not scale drawings.**

E. 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.

F. 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.

G. 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.

H. 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.

I. 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 11 13

WORK COVERED BY CONTRACT DOCUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General Notes applicable to all the Work of this Project and included in the Contract Documents.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Related documents are:
   1. All documents contained in the Contract Documents, information provided in Section 00 3100 - Available Project Information, and Owner provided information, including but not limited to:
      a. Drawings: All drawings.
      b. Specifications: Active Divisions 00 through 49.
      c. The agreement or contract between the Owner and the Contractor (“Construction Contract”).
      d. General Conditions of the contract.
      e. Supplementary Conditions of the contract.
      f. Bid documents.
      g. Geotechnical report.
   2. Codes, regulations, and statutes applying to the Work of this section, including Local, State, and Federal codes, regulations, and statutes.
      a. Verify prevailing building codes, energy conservation codes, utility codes, regulations, amendments, statutes, and other required laws, policies & procedures with the Authority Having Jurisdiction (AHJ) for the locale of this project.
   3. This project shall comply with the 2012 TAS and the 2010 ADA Standards and other relevant accessibility regulations, related documents and Authorities Having Jurisdiction (AHJ's) at applicable locations.
   4. Industry-related documents applying to selection, preparation, and installation of materials and systems generally accepted in the industry for work under this Section, and including the documents listed herein.
   5. The construction schedule prepared by the Contractor and provided to the Owner and Architect. All work under this Section shall be priced, bid, planned, coordinated, procured,

and installed in accordance with the construction schedule.

6. Whenever the word "Contractor" is used in these specifications and related construction documents, it is intended to mean the entity under contract to construct this project.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Refer to the "Related Requirements" article in each spec section.
C. Section 01 10 00 - Summary (Owner-furnished Section): Project information, work covered by Contract Documents, description of alterations work, Work by Owner, Owner-furnished products, access to the site, use of site & premises, occupancy conditions, specification and drawing conventions, work sequence, miscellaneous provisions, and additional information.
D. Section 01 25 00 - Substitution Procedures, for limitations and procedures for proposing substitutions.
E. Section 01 30 00 - Administrative Requirements, Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
F. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
G. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
C. NEMA MG 1 - Motors and Generators 2018.
D. TAS - 2012 Texas Accessibility Standards (TAS) 2012.
E. UL (DIR) - Online Certifications Directory Current Edition.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination of the Work of each section with all other sections and elements is required for this Project.
B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.6 GENERAL NOTES

A. Related Documents The following text is to communicate and emphasize that each element of the drawings and specifications is related and important, as are communication and cooperation of each member of the construction team for the satisfactory completion of this project:
    1. Related documentation, drawings and general provisions of the Contract, including General Conditions and Supplementary Conditions, and Division 01 Specification Sections (aka front end documents), apply to all Specification Sections.
    2. Sections referenced in the articles or paragraphs entitled “Related Requirements”, "Related Documents", "Section Includes", and/or similar lines and headings also apply to all Specification Sections.

3. Sections referenced within the above mentioned, or of similar title (or content), articles, paragraphs, lines and headings also apply to all Specification Sections. Other Sections not mentioned in these titles/headings but also affecting the Work of all Specification Sections also apply. This applies to all the Work of this Project.
    a. Definitions
        1) The term “Work” means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations. The Work may constitute the whole or a part of the Project.
        2) The term “Project” is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.
        3) The term “Product” means items acquired for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," “service,” and terms of similar intent.
    b. Other new or related Work, as may be required at new and existing construction affecting the Work of all Specification Sections shall be performed in a satisfactory professional manner. The Work shall not be adverse to any existing operations, warranties, or other satisfactory building function.
4. Compliance with Accessibility Standards
    a. This project shall comply with the **2012 TAS** and the **2010 ADA Standards** and other relevant accessibility regulations.
    b. All sites, facilities, buildings, and elements that are constructed or altered by, on behalf of, or for the use of the public shall be designed, constructed, or altered to be readily accessible to and usable by individuals with disabilities as defined by the governing standards and agencies. This includes products, supplies, items, finishes, equipment, and other effects (as well as their operation, placement and location) that constitute any part, assembly, or whole of the building & site, whether manufactured, fabricated, assembled, conditioned or constructed, on-site or off-site are required to be compliant with these standards. Providers of all effects shall become familiar with the standards and deliver such compliant effects. In cases where the contract documents appear to contradict the accessibility regulations, the provider shall contact the Architect for additional direction and clarification before installation or construction of the effect.”
    c. Refer also to other relevant accessibility regulations, related documents and Authorities Having Jurisdiction (AHJ's).

B. Coordinate work required which is not part of this construction contract for the timely, complete, and satisfactory execution of the Work of this Project. Any Work identified as by others or not part of any particular section is part of the the Construction Documents and is to be executed as indicated by the contracting entityunless identified below as work executed by others outside of this contract.
    1. Coordinate with Owner as required with the personnel for the separate contracts and work executed by others outside of this contract.

2. Hazardous material (Hazmat) abatement, shall executed by a separate contract as determined by the Owner.

C. It is the intent of these documents to construct an asbestos free and hazmat free project. In order to protect persons in contact with this project from any unnecessary exposure to any asbestos fibers, and to comply with the Asbestos Hazard Emergency Response Act it is prohibited to use any asbestos containing materials in all forms in the construction and operation of this facility.
   1. The Contractor shall provide an affidavit certifying that this project is asbestos free.
   2. The Contractor shall provide an affidavit from each subcontractor certifying that this project is asbestos free.

D. In new construction or alteration/renovation work, should the Contractor encounter previously unknown hazardous materials, the Contractor shall immediately cease Work and notify the Architect. Major Work for abatement and removal or treatment of such materials is not part of the Work of this contract.

E. Mold, mildew, and/or any other fungus is not allowed on this project. Any new materials which acquire this type of infection must be immediately removed from the project.
   1. Refer also to Section 09 21 16 - Gypsum Board Assemblies for specific procedures dealing with gypsum board installation.

F. Failure to comply with these requirements constitutes non-compliance with the specifications and an unacceptable project.

G. The Owner shall appoint and retain materials testing and construction observation services. When testing or observations reveal substandard, defective, non-compliant, or other wise unacceptable work, the Contractor shall correct such Work and bear the cost of retesting/observation where testing/observation had revealed the unacceptable work.

H. Preparation of new or existing substrate (this applies also to OFCI finishes, materials and equipment):
   1. New substrates shall be prepared as recommended by manufacturer of new work/ finish(es)/ material(s)/ product(s)/ equipment/ item(s) and/or any other new element(s).
   2. As applicable to new construction, cut, move, and remove existing finish(es), material(s), product(s), equipment, item(s), and/or other element(s) (hereinafter referred to as “existing element(s)”) and prepare substrate as necessary for application of adjacent new work/ finish(es)/ material(s)/ product(s)/ equipment/ item(s) and/or any other new element(s) (hereinafter referred to as “new work”) required for a complete and satisfactory professional installation.
   3. Prepare new and existing substrates and surfaces as required to receive new work/ finish(es)/ material(s)/ product(s)/ equipment/ item(s) and/or any other new element(s) application(s).
   4. Verify the compatibility of materials to each other. This applies to new and existing materials, substrates, and construction. Do not continue where materials are found to be non-compatible. Identify materials found not to be compatible and determine alternate procedures and/or material or materials which would be compatible. Follow substitution procedures for a request for substitution. Refer to Section 01 2500 - Substitution Procedures and Section 01 6000 - Product Requirements, for substitution limitations and procedures.

I. Temporary Removal

1. Work of the respective specification section for new Work over existing construction or newly installed existing construction may include temporary removal of "existing new elements" or "existing elements", repair and preparation of existing substrate(s) required for a proper, complete and satisfactory professional installation of new work.
2. Carefully cut, move, or remove other existing elements to remain, as necessary for access or proper application of alterations and renovation work. Replace and restore in working order at completion to a finished condition indistinguishable from the new work.
3. When removed material(s)/equipment or adjacent material(s)/equipment are damaged or beyond acceptable reuse they are to be replaced with new material(s)/equipment to match the undamaged existing material(s)/equipment. Close match is not acceptable. Replacement materials must be acceptable to the Architect and the Owner. This shall apply to all surfaces (e.g. floors, walls, ceilings, exterior surfaces, etc.) and all elements (e.g. doors, frames, windows, louvers, hatches, MEP elements, all fixtures, landscaping, other interior and exterior elements, etc.), contained in, on, above, below or around those surfaces or locations. This applies to damage on account of the activities of the Work of the various respective specification sections for new Work at or around existing construction.

J. Installation of Hardware at Door, Cabinet and other Owner sensitive Door/Finish Hardware.
1. This requirement shall be for any product or unit that will require installation of all door hardware and locks that are to receive a core with the Owner keyway.
2. Door Hardware, Cabinet locks and other Owner sensitive hardware shall be <u>installed by the hardware supplier</u>, except where the hardware is traditionally provided to other suppliers such as storefront manufacturers and other manufacturers requiring their installation. Hardware supplier shall provide experienced factory trained personnel who have completed installations similar in material, design, and extent to that indicated for this Project and whose Work has resulted in construction with a record of successful in-service performance. Hardware installation shall be under the direction and control of an Architectural Hardware Consultant (AHC) or an Architectural Openings Consultant (AOC). Self-installation by Contractor or any other contractor/entity shall not be allowed. Prior to Substantial Completion, hardware supplier and supervising Architectural Hardware Consultant (AHC) or Architectural Openings Consultant (AOC) shall perform a final inspection of installed door hardware and state in written report whether Work complies with or deviates from requirements, including whether door hardware is properly installed, operating, adjusted, and in compliance with the Texas Accessibility Standards (TAS).

K. Required anchorage at roof:
1. Anchorage and anchor design of any manufactured element and additional necessary interstitial members needed for attachment on the roof shall be provided to resist the uplift and sliding forces that result from the application of the prescribed wind uplift roof load. These elements include but are not limited to:
   a. Equipment
   b. Vents
   c. Ductwork
   d. Hoods
   e. Screens
   f. Antennas

g. Drains
h. Piping
i. Switches & other control devices
j. Lightning protection
k. Canopies
l. Sun Screens and Louvers
m. Overhangs
n. Roof Access Hatches
o. Railing
p. Decorative or design element(s)

2. This requirement supersedes any language in any specification section, shop drawing, or other document(s), which do not meet or exceed the roof load requirements.
3. The load requirement at the roof shall be determined by the strictest of the requirements by authorities having jurisdiction, which are applicable to the location of the project site.

L. Provide separation from Owner occupied and unoccupied areas.
1. Refer to the drawings for lines of separation.
2. At Work in an existing building which is to be occupied during construction and renovation, alteration, remodel, expansion, addition, or any improvement is to take place, the Contractor shall provide continuous separation from the occupied space.
a. Provide polyethylene dust barriers and self-closing door passages with continuous magnetic strips on each open edge. Door(s) shall be of a width sufficient for the traffic and equipment expected to pass through.
b. Provide temporary peel-away adhesive surface walk-off mats to capture dust on contact at each door or passageway. Provide on both sides of interior passageways.
c. At expansions, additions, and / or repairs involving existing exterior walls, provide a temporary weather tight, insulated and secure wall including door(s). Where required, the temporary wall shall be fire-rated to comply with the prevailing Building Code.

M. On renovation/alteration/remodel Work at existing buildings, this contractor shall include in their responsibilities the care and maintenance of the HVAC filters and return air grills for the area(s) which the Work of this contract occurs. The filters shall be examined weekly and replaced with clean filters appropriate to the unit. Upon Substantial Completion clean/new filters shall be placed in the HVAC units and all coils for the HVAC units shall be cleaned.

N. Debris, rubbish, trash, waste and other matter to be disposed of throughout this project shall be handled in a thorough, neat, proper, legal, and expeditious manner.

O. Utility and other agency assessments and impact fees which are traditionally not known prior to the bidding of this project shall not be included in the contract.

P. Permits, fees, licenses, inspections, and other charges which are discoverable prior to bidding are included in the work of this Contract. Refer to the General Conditions.

Q. The use of explosives is not allowed.

R. Concrete Rubbing - All exposed concrete shall be rubbed to a uniform finish to match the approved mock-up described below
1. Mock-Up:
a. Rubbed concrete shall be smooth, flat, free of physical and visual blemishes to a uniform and satisfactory surface to the approval of the Architect and Owner.

b. Provide one Mock-up 4 feet (1.22 m) wide x 4 feet (1.22 m) high illustrating the proposed rubbed finish.
c. Locate where directed.
d. Mock-Up may not remain part of the work.
e. Do not remove Mock-Up until directed by Owner.

2. Surface Finish:
   a. Immediately after the removal of forms, all cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other defects shall be cleaned, dampened and completely filled, pointed or trued with a mortar of the same proportions as used in the concrete being finished.
   b. Exposed surfaces which are not satisfactory to the Engineer because of excessive patching and/or other corrective work, shall be grout cleaned or rubbed as required by the Engineer.
   c. Other contiguous exposed surfaces on the structure shall be finished in a similar manner to the extent required to produce a uniform appearance.
   d. On all exposed surfaces, all fins and irregular projections shall be removed with a stone or power grinder, care being taken to avoid contrasting surface textures. Sufficient white cement shall be substituted for the regular cement in the filling of holes and other corrective Work to produce finished patches of the same color as the surrounding concrete.
3. Grout Cleaning:
   a. Where grout cleaning is called for on the plans or is necessary for corrective work, the surface, after wetting, shall be uniformly covered with a grout consisting of one part cement to 1 1/2 parts fine sand, and sufficient water to produce a consistency of thick paint.
   b. White portland cement shall be used for all or part of the cement in the grout, as directed by the Engineer, to give the color required to match the concrete.
   c. The grout shall be uniformly applied with brushes or a spray gun, and all air bubbles and holes shall be completely filled. Immediately after the application of the grout, the surface shall be vigorously scoured with a cork or other suitable float. While the grout is still plastic the surface shall be finished with a sponge rubber or other suitable float removing all excess grout. The finishing shall be done at the time when grout will not be pulled from the holes or depressions.
   d. After being allowed to thoroughly dry, the surface shall be vigorously rubbed with a dry burlap to completely remove any dried grout. There shall be no visible film of grout remaining on the surface after this rubbing and the entire cleaning operations of any area must be completed on the day it is started.
   e. If any dark spots or streaks remain after this operation, they shall be removed with a fine grained silicon carbide stone, but the rubbing shall not be sufficient to change the texture of the surface.
4. Rubbed Finish:
   a. Forms shall be removed, if possible, within two days after concrete is placed. Corrections shall be made as outlined above.
   b. Rubbing of concrete shall be started as soon as the conditions will permit.

c. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of two hours. Sufficient time shall have elapsed before wetting down to allow the mortar used in pointing insert holes and defects to be thoroughly set.
d. Surfaces to be finished shall be rubbed with a medium coarse silicon carbide stone until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been attained. The paste produced by rubbing shall be left in place at this time. No additional material other than water shall be applied to the surface.
e. After all concrete above the surface being finished has been placed, the final finish shall be obtained by rubbing with a fine silicon carbide stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform in color.
f. Any surfaces which have been given a rubbed finish, shall be protected from subsequent construction operations.
g. Any surfaces which are not protected shall be cleaned and again rubbed, if necessary, to secure a uniform and satisfactory surface.
h. No extra payment will be made for any type of surface finish, the cost being considered as included in the price bid for concrete.

S. When working with an existing building, provide a secure and weather tight building at all times.
T. Facility is licensed under Texas Department of State Health Services and will require 80 percent and 1 percent inspections.

1.7 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.8 QUALITY ASSURANCE

A. The Work of each section of these specifications shall be executed by an entity with a minimum experience level in the work described as expressed in the section.
B. Where the experience level is not expressed it shall be known here that the experience level must be at least five (5) years of documented experience in the Work of the specification section. Contractors and subcontractors must be able to show recent examples of their Work (up to (3) three) in the local area.
C. Products and fabrications shall be made by manufacturers/fabricators with a minimum experience level expressed in the specification section.
D. Where the experience level of the manufacturer/fabricator/contractor is not expressed it shall be known here that the experience level must be at least five (5) years of documented experience in the product or fabrication or service of the items/work described in the specification section.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROTECTION

A. Protect each part of work from subsequent adjacent construction operations for each application, step, stage, or process involved.

B. Do not permit traffic over unprotected floor surface or at areas where any part of the work may be damaged, compromised, or in any way undermined.

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 22 00

UNIT PRICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. List of unit prices, for use in preparing Bids.
B. Measurement and payment criteria applicable to Work performed under a unit price payment method.

1.2 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.3 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
B. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect.
C. Assist by providing necessary equipment, workers, and survey personnel as required.
D. Measurement Devices:
    1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
    2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
    3. Metering Devices: Inspected, tested and certified by the applicable state department within the past year.
E. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
F. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
G. Measurement by Area: Measured by square dimension using mean length and width or radius.
H. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
I. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

1.4 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
B. Payment will not be made 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 the transporting vehicle.
4. Products placed beyond the lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected Products.

1.5 DEFECT ASSESSMENT

A. Replace Work, or portions of the Work, not complying with specified requirements.
B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct one of the following remedies:
   1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Architect.
   2. The defective Work will be partially repaired to the instructions of the Architect, and the unit price will be adjusted to a new unit price at the discretion of Architect.
C. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct one of the following remedies:
   1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Owner.
   2. The defective Work will be partially repaired to the instructions of the Owner, and the unit price will be adjusted to a new unit price at the discretion of Owner.
D. The individual specification sections may modify these options or may identify a specific formula or percentage price reduction.
E. The authority of Architect to assess the defect and identify payment adjustment is final.

1.6 SCHEDULE OF UNIT PRICES

A. Addition for Chain Link Fencing per lineal foot for furnishing and installing fencing, except gates; cleaning, grading, and backfilling; removing and disposing of surplus material; and equipment, labor, tools, and incidentals:
   1. Unit Price No. 1 - Addition for Chain Link Fencing: $_____ per lf.
B. Addition for Gate per instance for furnishing and installing pedestrian and vehicular gates; materials, center anchorages, equipment, labor, tools, and incidentals:
   1. Unit Price No. 2 - Addition for Pedestrian Gate: $_____ per ea.
   2. Unit Price No. 3 - Addition for Vehicular Gate: $_____ per ea.

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 a digital copy 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 the Contract Drawings will be provided by Architect/Engineer 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/Engineer 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/Engineer 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/Engineer and to Architect's consultants, allow 21 days for review of each submittal. Submittal will be returned to Architect/Engineer 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/Engineer 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/Engineer 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/Engineer
      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/Engineer 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/Engineer 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/Engineer 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/Engineer 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 electronic copies to Contractor and Architect/Engineer.

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. Provide shop drawing submittals for each engineering specialty at the same time.

B. Submittals shall be arranged in sequence by Specification section number. Provide submittals only for specification sections that list this requirement.
1. Provide tabs for each section, labeled to match the associated specification. The page after each tab section shall contain a list of any exceptions that the Contractor is proposing.
2. Each page of the submittal shall be a clear copy or scan, indicating items and options proposed for use in the project with a graphical arrow. Items included on a submittal page that are not proposed for use shall be deleted with strike-through or other acceptable method that clearly distinguishes the proposed from non-relevant information.

C. Subject to the requirements in Division 1, submittals shall be provided in PDF form.
1. All format and informational requirements for submittals in binders apply to PDF submittals.
2. Multiple files may be submitted; however, these must be organized into a consistent format.

3. PDF submittal shall include a table of contents with page numbers listed for the beginning of each section.
4. Additionally, the PDF shall be formatted to include tab or chapter shortcuts, labeled with the associated specification section. These shortcuts shall allow the reader to jump to a tab or chapter associated with beginning of each specification section with a single action.
5. At Architect/Engineer's request, the Contractor shall submit hard copy versions in accordance with requirements outlined above.

D. Provide closeout submittals for all products used. Refer to related specification section for additional requirements.

E. Provide maintenance and warranty information with contact information for parts and service of equipment.

F. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
1. Dimensions
2. Identification of products
3. Fabrication and installation drawings
4. Roughing-in and setting diagrams
5. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
6. Shopwork manufacturing instructions
7. Templates and patterns
8. Schedules
9. Design calculations
10. Compliance with specified standards
11. Notation of coordination requirements
12. Notation of dimensions established by field measurement
13. Relationship to adjoining construction clearly indicated
14. Seal and signature of professional engineer if specified
15. Wiring Diagrams: Differentiate between Manufacturer-installed and field-installed wiring

G. 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.

H. Number of Copies: Submit five opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Architect/Engineer will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing

I. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

J. All work must ultimately comply with the contract documents unless Architect/Engineer gives specific written acceptance of specific deviations.

K. 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/Engineer 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/Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

A. Action Submittals: Architect/Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect/Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

B. Informational Submittals: Architect/Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect/Engineer 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 55 00

STABILIZED CONSTRUCTION ENTRANCE/EXIT

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item will be used temporarily during construction to control the tracking of sediment, mud, gravel, etc., from a construction site or other areas identified by the Project Engineer or Owner's Representative to a public right of way, street, sidewalk or parking area.

PART 2 – PRODUCTS

2.1 MATERIALS

A. All materials shall meet the applicable requirements as indicated below for the specified type of construction exit.

B. Rock Construction Exit. Rock used for long- and short-term construction exits shall consist of crushed stone. The aggregates shall be clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.

C. Timber Construction Exit. Timber for long-term construction exits shall consist of treated railroad ties and timbers. The railroad ties and timbers shall be treated to control rot and shall be No. 2 quality or better and free of large and loose knots. Timber shall be fastened with nuts and bolts or lag bolts all of which shall meet or exceed ASTM - A307. Timber for short-term construction exits shall be treated to control rot and shall be No. 2 quality or better and free of large and loose knots. Plywood and/or pressed wafer board shall be a minimum of 1/2 inch [13 mm] thick.

D. Foundation Course (when required). The foundation course shall be flexible base, bituminous concrete, portland cement concrete or other materials as approved by the Project Engineer or Owner's Representative.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. When tracking conditions exist, traffic shall not be allowed to cross or leave the construction site and move directly onto a public roadway, alley, sidewalk, parking area, or other right of way in areas other than at locations of construction exits. Construction exits can be either for long or short term use. Foundation courses, if needed, shall be used with the long-term construction exits.

1. Long-term Construction Exit. The exit shall be placed over a foundation course, if needed. The foundation course and/or compacted subgrade shall be properly graded to direct runoff from the construction exit to a sediment trap as shown on the plans or as directed by the Project Engineer or Owner's Representative. The exit shall normally be constructed a minimum length of 50 feet [15 m]. The width shall be at least 14 feet [4.3 m] for one-way traffic and 20 feet [6 m] for two-way traffic but shall not be less than full width of all points of ingress and egress and shall be sufficient for all ingress and egress.
   a. Type 1 Construction Exit. This exit shall consist of open-graded crushed stone with a size of 4 - 8 inches [102 mm- 203 mm] as shown on the plans. The depth of the aggregate shall not be less than 8 inches [203 mm].
   b. Type 2 Construction Exit. This exit shall be constructed of treated railroad ties and timbers as shown on the plans.
2. Short-term Construction Exit.

a. Type 3 Construction Exit. This exit shall be used for daily operations when tracking conditions exist such as traffic crossing the construction site at locations where long-term exits are not practicable. This exit shall be either open-graded crushed stone with a size of 2 or 4 inches [50 mm - 102 mm]. The length shall be a minimum of fifty feet (50') or as effective. A minimum thickness of eight inches (8") will be required. The width shall not be less than all points of ingress and egress. This exit must be properly graded or incorporate a drainage swale to prevent runoff from leaving the construction site.
b. Type 4 Construction Exit. This exit shall be as shown on the plans.

3.2 MAINTENANCE

A. Exits shall be maintained in a condition that will prevent tracking or flowing of sediment onto public right of way. This may require periodic removal and replacement of stone or timber, or other material as conditions demand and repair and/or clean out of any measures used to trap sediment. Sediment spilled, dropped, washed or tracked onto public right of way shall be immediately removed by the Contractor and disposed of at an approved site and in a manner that will not contribute to additional siltation.
B. When necessary, wheels shall be cleaned to remove sediment prior to entrance onto public right of way. When washing is required it shall be done on an area stabilized with crushed stone which allows the wash water to drain into an approved trap, sediment basin, or truck washout pit. All sediment shall be prevented from entering any storm drain, ditch, or watercourse using approved methods.
C. When necessary or when directed by the Project Engineer or Owner's Representative, the construction exits may be removed and/or replaced as many times as needed.
D. The construction exits shall be removed promptly when directed by the Project Engineer or Owner's Representative. Discarded materials shall become the property of the Contractor for his disposal at an approved site. The area beneath the construction exit and any area damaged by the removal process shall then be stabilized by the Contractor using appropriate methods as approved by the Project Engineer or Owner's Representative. Stabilization shall be as defined by Section No. 01 57 13, "Temporary Erosion Controls".

END OF SECTION

SECTION 01 57 13

TEMPORARY EROSION CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Item shall govern the control measures necessary to prevent and control soil erosion, sedimentation and water pollution during construction which may degrade receiving waters including rivers, streams, lakes, reservoirs, tidal waters, groundwater and wetlands. The control measures contained herein shall be installed and maintained throughout the construction contract and coordinated with the permanent or existing temporary pollution control features as specified on the Storm Water Pollution Prevention Plan (SWPPP); and in the specifications to assure effective and continuous water pollution control throughout the construction and post construction period. These control measures shall not be used as a substitute for the permanent pollution control measures unless otherwise directed by the Project Engineer or Owner's Representative in writing. The controls may include sediment control fences, baled hay, rock filter dams, dikes, swales, sediment traps and basins, pipe slope drains, paved flumes, construction exits, temporary seeding, sodding, mulching, soil retention blankets or other structural or non-structural water pollution controls. This item does not apply to commercial operations.

B. Discharges of storm water runoff from the construction activities of this project shall be addressed in the SWPPP prepared by the Engineer and executed by the Contractor, and shall be authorized under the Texas Pollutant Discharge Elimination System (TPDES) General Permit, TXR150000, as issued on February 15, 2008, by the Texas Commission on Environmental Quality (TCEQ) pursuant to Section 26.040 of the Texas Water Code and Section 402 of the Clean Water Act.

C. This specification shall apply to construction projects of less than five (5) acres of disturbed area in accordance with the eligibility requirements of Part II.E.1 of the general permit.

D. Discharges eligible for authorization under Part II.E.1 of the general permit include:

1. Storm water runoff associated with construction activities.
2. Storm water runoff associated with construction support activities including concrete batch plants, asphalt batch plants, equipment staging areas, material storage yards, material borrow areas, and excavated materials provided that these support activities are within a one (1) mile distance from the boundary of the permitted construction site, directly supports the construction activity, addressed by the SWPPP, and do not operate beyond completion date of the construction activities.
3. Non-storm water related discharges that are strictly limited to:
   a. Fire fighting activities;
   b. Fire hydrant flushings;
   c. Vehicular, external building, and pavement wash water where no detergents and soaps are used and where spills or leaks of toxic and/or hazardous materials has not occurred.
   d. Water used to control dust;
   e. Potable water sources including waterline flushings;
   f. Uncontaminated ground water or spring water, including foundation or footing drains where flows are not contaminated with industrial materials such as solvents.

E. This permit does not provide the general public with any right to trespass on a construction site for any reason, including inspection of a site; nor does this permit require that permittees allow members of the general public access to a construction site.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The items, estimated quantities and locations of the control measures will be shown in the SWPPP; however the Contractor to verify quantities prior to bid. The materials will be shown on the SWPPP Site Map and in the specifications. Pollution control measures may be applicable to contractor operations outside the right of way where such work is necessary as a result of roadway related construction such as construction and haul roads, field offices, equipment and supply areas, and materials sources.

B. Stabilized Construction Exit. The construction entrance shall conform to the provisions of Section 01 55 00 "Stabilized Construction Entrance/Exit", or as noted in the SWPPP.

C. Silt Fencing. Silt fence shall conform to the provisions of Section 01 57 13.13 "Temporary Sediment Control Fence (Silt Fence)", or as noted in the SWPPP.

D. Temporary Truck Washout Pit. The truck washout pit shall conform to the provisions of Section 01 57 13.19 "Truck Washout Pit", or as noted in the SWPPP.

E. Seeding for Permanent Erosion Control. Seeding shall conform to the TxDOT Standard Specifications, Item 164“ Seeding for Erosion Control.”

PART 3 – EXECUTION

3.1 PRE-CONSTRUCTION SUBMITTALS

A. Discharge from sites where the commencement of construction occurs on or after the issuance date of the general permit must be authorized prior to the commencement of those construction activities.

B. The Contractor shall implement the erosion controls according to the SWPPP.

C. The Contractor shall complete, sign, and date the Notice of Intent (NOI) Form # 20022 included with the SWPPP. Instructions for completing the form are also included.

D. The Contractor shall submit the NOI Form and the processing fee of the addresses as indicated on the form prior to commencing construction activities. Also the Contractor must post a signed copy of the NOI at the construction site in a location where it is readily available for viewing by the general public, local, state, and federal authorities. The Contractor is responsible for maintaining the notice in the designated location until completion of all construction activity.

E. Once the SWPPP is implemented and the notice is complete, submitted, and posted, the contractor is provisionally authorized two days from the postmark date of the NOI under the general permit as in compliance with Part II.D.3 of the TPDES, and construction activities may begin. Authorization will be non-provisional when the NOI is accepted and issued an authorization number.

F. A copy of the SWPPP must be retained on-site at the construction site or, if the site is inactive or does not have an on-site location to store the plan, a notice must be posted describing the location of the SWPPP. The SWPPP must be made readily available at the time of an on-site inspection to: the executive director; a federal, state, or local agency approving sediment and erosion plans, grading plans, or storm water management plans; local Project Engineer or Owner's Representative officials; and the operator of a municipal separate storm sewer receiving discharges from the site.

G. The SWPPP shall be updated as necessary to reflect the changing conditions of new operators, new areas of responsibility, and changes in best management practices and prepared so that it provides for compliance with the terms and conditions of this general permit.

3.2 CONSTRUCTION REQUIREMENTS

A. The Contractor shall provide control measures to prevent or minimize the impact to receiving waters as required by the SWPPP and/or as directed by the Project Engineer or Owner's

Representative in writing. Storm water discharges associated with industrial activities (such as hot mix plants, concrete batch plants or material handling areas) must comply with the terms of the TCEQ's TPDES general permit.

B. Inactive construction areas are defined as areas in which no construction activity will occur for a period of 30 days or longer. Inactive construction areas that have been disturbed will require stabilization through the use of vegetation, mulch, erosion control matting or structural methods within 7 calendar days from the last construction activity in the area. At all times prior to stabilization, inactive construction areas shall be considered as active, disturbed construction area, contributing to the sediment loading at the site control systems. After stabilization, inactive construction areas will be considered undisturbed areas, eliminating the contribution of sediment to the erosion control devices.

C. The Contractor shall effectively prevent and control erosion and sedimentation on the site at the earliest practicable time as outlined in the SWPPP schedule. Control measures, where applicable, will be implemented prior to the commencement of each construction operation or immediately after the area has been disturbed.

D. The Contractor shall limit the amount of disturbed earth to the area(s) shown on the plans or as directed by the Project Engineer or Owner's Representative

E. Should the control measures fail to function effectively, the Contractor shall act immediately to bring the erosion and sedimentation under control by maintaining existing controls or by providing additional controls as directed by the Project Engineer or Owner's Representative. When in the opinion of the Project Engineer or Owner's Representative, the site is adequately stabilized, the control measures, excepting mulches and soil retention blankets, will be removed and properly disposed of by the Contractor. Soil retention blankets shall be removed only when, in the opinion of the Project Engineer or Owner's Representative, final permanent perennial seeding would be adversely affected by the presence of an existing soil retention blanket.

F. All erosion, sediment and water pollution controls will be maintained in good working order. A rain gauge shall be provided by the Contractor and located at the project site. Within 24 hours of a rainfall event of 0.5 inch [13 mm] or more as measured by the project rain gauge, the Contractor and Inspector will inspect the entire project to determine the condition of the control measures. Sediment will be removed and devices repaired as soon as practicable but no later than 7 days after the surrounding exposed ground has dried sufficiently to prevent further damage from equipment needed for repair of control measures.

G. In the event of continuous rainfall over a 24-hour period, or other circumstances that preclude equipment operation in the area, the Contractor will hand carry and install additional backup devices as determined by the Project Engineer or Owner's Representative. The Contractor will remove silt accumulations and deposit the spoils in an area approved by the Project Engineer or Owner's Representative as soon as practical. Any corrective action needed for the control measures will be accomplished in the sequence directed by the Project Engineer or Owner's Representative; however, areas adjacent to bodies of water shall generally have priority followed by devices protecting storm sewer inlets.

3.3 CONTRACTOR RESPONSIBILITIES

A. The contractor shall also conform to the following practices and controls. All labor, tools, equipment and incidentals to complete the following work will not be paid for directly, but shall be considered as subsidiary work to the various items included in the contract, unless otherwise noted.

1. Disposal areas, stockpiles and haul roads shall be constructed in a manner that will minimize and control the amount of sediment that may enter receiving waters. Disposal areas shall not be located in any wetland, waterbody or stream bed. Construction roads may not be located in or across any waterbody or stream bed without prior approval of

the Project Engineer or Owner's Representative and shall be done in compliance with applicable rules and regulations.

2. Construction operations in rivers, streams, lakes, tidal water wetlands and other waterbodies shall be restricted to those areas where it is necessary to perform the work shown on the plans. Wherever streams are crossed, temporary bridges, timber mats or other structures shall be used.
3. Protected storage for paints, chemicals, solvents, fertilizers and other potentially toxic materials will be provided by the Contractor at a location approved by the Project Engineer or Owner's Representative.
4. Construction staging areas and vehicle maintenance areas shall be constructed by the Contractor in a manner to minimize the runoff of pollutants. Those areas located on the right of way must be approved by the Project Engineer or Owner's Representative. The Contractor shall prevent pollution of receiving waters with petroleum products or other hazardous or regulated substances. When work areas or material sources are located adjacent to a waterbody, control measures shall be used to keep sediment and other contaminants from entering the adjacent waterbody. Control devices located on the right of way will be measured for payment. Care shall be taken during the construction and removal of control measures to minimize down-gradient sedimentation.
5. All waterways shall be cleared as soon as practicable of temporary embankment, temporary bridges, matting, false work, piling, debris or other obstructions placed during construction operations that are not a part of the finished work.
6. Disturbance of vegetation shall be minimized and limited to only what is shown on the construction plans or as directed by the Project Engineer or Owner's Representative in writing.
7. The Contractor shall clean paved surfaces as necessary to remove sediment that has accumulated on the roadway.
8. The Contractor must revise or update the SWPPP whenever: a.) there is a change in design, construction, operation, or maintenance that has a significant effect on the discharge of pollutants and that has not been previously addressed in the SWPPP as directed by the Project Engineer or Owner's Representative; or b.) results of inspections or investigations by site operators, operators of a municipal separate storm sewer system receiving the discharge, authorized TCEQ personnel, or a federal, state or local agency approving sediment and erosion plans indicate the SWPPP is proving ineffective in eliminating or significantly minimizing pollutants in discharges authorized under this general permit.
9. If silt and/or sediment escapes the site, accumulations must be removed at a frequency to minimize further negative effects, and whenever feasible, prior to the next rain event.

B. If the Contractor is required to install temporary erosion, sediment and water pollution control measures due to his negligence, carelessness, lack of maintenance, or failure to install permanent controls as a part of the work as scheduled, and measures are ordered in writing by the Project Engineer or Owner's Representative, such work shall be performed at the Contractor's expense. All labor, tools, equipment and incidentals to complete the work will be considered subsidiary to the various bid items, unless otherwise noted.

C. When the need for control measures can not be attributed to the Contractor's negligence, carelessness, lack of maintenance or failure to install permanent water pollution control measures and these measures are shown on the plans and/or directed by the Project Engineer or Owner's Representative, these measures shall be measured and paid for in accordance with applicable contract bid items. For work performed under the requirements of this section that are not comparable to work performed under contract bid items, such work shall be performed on a force account basis or by agreed unit prices. Removal of control measures not

incorporated as permanent control measures shall be measured and paid for in accordance with applicable contract bid items.

D. In case of failure on the part of the Contractor to prevent and control soil erosion, sedimentation and water pollution which may degrade receiving water, the Project Engineer or Owner's Representative reserves the right to employ outside assistance or to use State forces to provide the necessary corrective measures. All costs including engineering costs will be deducted from any moneys due or to become due to the Contractor.

3.4 PROJECT ACCEPTANCE

A. The project will not be accepted until the Contractor provides a uniform perennial vegetative cover with a density of 70% of adjacent undisturbed areas, or, if in the opinion of the Project Engineer or Owner's Representative, permanent measures (such as rip-rap, gabions, or geotextiles), supplemented by temporary measures (such as mulching with seed, hay bales, sediment control fences, earth dams, etc.) have been employed that will control erosion, sedimentation and water pollution until sufficient vegetative cover can be established.

3.5 COMPLETION

A. For areas of the State that have an average annual rainfall less than 20 inches and where construction operations have ceased for an extended period of time, the disturbed area shall be stabilized as soon as possible. For all areas of the State with an average annual rainfall greater than 20 inches, in any disturbed area where construction activities have ceased, permanently or temporarily, the Contractor shall initiate stabilization of the area by the use of seeding, mulching, soil retention blankets or other appropriate measures within 14 days, except in areas where construction activities are scheduled to resume within 21 days.

B. When final stabilization has been achieved on all portions of the site covered under the requirements of the general permit, the SWPPP will be complete. The Contractor shall within thirty (30) days complete, sign, and date the Notice of Termination (NOT) Form #20023 included in the SWPPP. Instructions for completing the form are also included. The Contractor shall submit the NOT to the address indicated on the form.

END OF SECTION

SECTION 01 57 13.13

TEMPORARY SEDIMENT CONTROL FENCE
(SILT FENCE)

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item shall govern for the materials to be furnished and for the installation, maintenance and removal of temporary sediment control fence of the dimensions shown on the plans. This item will be used temporarily during construction to control erosion and sedimentation.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Fence Description. The fence shall be a net-reinforced fence, using woven geotextile fabric.

B. Fabric. Fabric may be manufactured from polyester, polypropylene or polyamide and shall be resistant to ultraviolet degradation, mildew and rot and shall be suitable for use in a wet soil and stagnant water environment. The edge of woven fabric shall be sealed or selvedge to prevent raveling. Fabric shall be at least 36 inches [1 m] wide with 6 to 8 inches [152 mm - 203 mm] inches of the width buried in a trench to prevent undercutting, unless specified otherwise on the plans.

C. Posts. Posts shall be a minimum of 48 inches [1.2 m] long, essentially straight, and shall be wood or steel, unless otherwise shown on the plans. Soft wood posts shall be at least 3 inches [76 mm] in diameter or nominal 2x4 inches [50 mm x100 mm]. Hardwood posts shall have a minimum cross section of 5 x 1.5 inches [38 mm x 38 mm]. Steel posts shall be "T" or "L" shaped with a minimum weight of 1.3 pounds per linear foot [6.3 kg per meter].

D. Net Reinforcement. Net reinforcement shall be galvanized welded wire mesh of a minimum 12.5 gauge wire or equal as approved by the Project Engineer or Owner's Representative with a maximum opening size of 2 inches [50 mm] by 4 inches [102 mm] and shall be at least 24 inches [610 mm] wide unless otherwise shown on the plans.

E. Staples. Staples used to secure reinforcement and fabric to wood posts shall have a crown at least 3/4 inch [19 mm] wide and legs 1/2 inch [13 mm] long.

F. Used Materials. Previously used materials, meeting the above requirements and when approved by the Project Engineer or Owner's Representative, may be used.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. The temporary sediment control fence shall be used during construction near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. The fence may be incorporated into the erosion control measures used to control sediment in areas of higher flow. The fence installation methods shall be as specified below, unless otherwise shown on the plans. The physical alignment and location of the fence shall be as shown on the plans or as directed by the Project Engineer or Owner's Representative.

B. Installation of Post. Posts shall be embedded 18 inches [457 mm] deep, or adequately anchored if in rock, with a spacing of 6 to 8 feet [2 m -2.4 m], and installed on a slight angle toward the anticipated run-off source.

C. Fabric Anchoring. Trenches shall be dug along the uphill side of the fence to anchor 6 to 8 inches [152 mm - 203 mm] of fabric. The trench shall have a minimum cross section of 6 x 6 inches [150 mm x 150 mm]. The fabric shall be installed in the trench such that 4 to 6 inches [102 mm - 152 mm] of fabric is against the side of the trench and approximately 2 inches [50

mm] of fabric is across the bottom in the upstream direction. The trench shall then be backfilled and hand tamped as approved by the Project Engineer or Owner's Representative.

D. Fabric Attachment. The reinforcement shall be attached to the end posts, if wood, by staples, or if steel, by T-clips or sewn vertical pickets at a minimum of 4 locations. The reinforcement shall be attached to each succeeding post as approved by the Project Engineer or Owner's Representative. The ends of successive reinforcement sheets or rolls shall be connected at a fence post at least 6 times with hog rings. The fabric shall be fastened to the top strand of reinforcement by hog rings or cord at a maximum spacing of 15 inches [381 mm].

E. Fabric Splices. Splices shall occur at a fence post and shall have a minimum lap of 6 inches (152 mm) attached in at least six places. Splices in concentrated flow areas will not be permitted.

3.2 MAINTENANCE

A. The temporary sediment control fence shall be maintained in good condition (including staking, anchoring, tension adjustments, etc.) by the Contractor. All necessary work and materials to maintain the integrity of the fence, including keeping fabric free of accumulated silt, debris, etc., shall be provided until earthwork construction and permanent erosion control features are in place and/or the disturbed area has been adequately stabilized. The areas damaged by the removal process shall be stabilized by the Contractor using appropriate methods as approved by the Project Engineer or Owner's Representative.

B. Torn or punctured fabric shall be repaired by the placement of a patch consisting of an additional layer of fabric over the damaged area. The patch shall have a minimum overlap of 18 inches [457 mm] in all directions and be securely attached to the repaired fabric.

C. When the accumulated sediment deposit reaches a depth of approximately 6 inches [152 mm], it shall be removed and disposed of at approved sites in a manner that will not contribute to additional siltation. If the structure ceases to function as intended, the Project Engineer or Owner's Representative may direct that the fence or portions thereof be replaced.

END OF SECTION

SECTION 01 57 13.16

EROSION AND SEDIMENTATION CONTROL MATERIALS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Item shall govern for the installation, maintenance, and removal of baled hay utilized temporarily during construction to control erosion and sedimentation.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The hay bales shall weigh a minimum of 50 pounds, be composed entirely of vegetable matter, and measure at least 30 inches in length. They shall be bound by wire, nylon or polypropylene string.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. The hay bales shall be installed in accordance with the details and at the locations shown on the plans by embedding in the soil a minimum of 4 inches, and where possible, approximately one half the height of the bale, or as directed by the Project Engineer or Owner's Representative.

B. Gaps between bales shall be filled with hay.

3.2 MAINTENANCE

A. The baled hay installation shall be maintained in good condition by the Contractor. All necessary work and materials to maintain the integrity of the installation shall be provided until permanent erosion-control features are in place and/or the disturbed area has been adequately stabilized. The area beneath the baled hay and area damaged by the removal process shall then be stabilized by the Contractor using appropriate methods as approved by the Project Engineer or Owner's Representative.

B. When the accumulated sediment reaches a depth of approximately 6 inches, it shall be removed and deposited at approved sites in a manner that will not contribute to additional siltation. If the installation ceases to function as intended due to washouts, etc., the Project Engineer or Owner's Representative may direct that the installation or portions thereof be replaced. Such replacement will be measured for payment.

END OF SECTION

SECTION 01 57 13.19

TEMPORARY TRUCK WASHOUT PIT

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item shall govern for the materials to be furnished and for the installation, maintenance and removal of the temporary truck washout pit. This pit shall is provided to receive wash water from construction trucks operating on the project site in order to minimize the accumulation of silt, mud, and other debris onto adjacent existing pavements. Excess concrete shall not be disposed of within the pit.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Hay Bales. The hay bales shall weigh a minimum of 50 pounds, be composed entirely of vegetable matter, and measure at least 30 inches in length. They shall be bound by wire, nylon or polypropylene string.

B. Reinforcing Steel: All reinforcing steel shall conform to the provisions of Section No. 03 20 00, "Civil Concrete Reinforcement".

C. Silt Fence (optional). Silt fencing may be used instead of hay bales. All silt fencing shall conform to the provisions of Section No. 01 57 13.13 Temporary Sediment Control Fence (Silt Fence)."

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. The truck washout pit shall be located in an area easily accessible to construction traffic near or next to the stabilized construction exit, as shown in the SWPPP. The pit shall be located in an area protected from storm water runoff. The contractor shall ensure positive surface drainage flow from the truck wash location into the pit.

B. The minimum size of the pit shall be eight feet (8') by six feet (6') or as otherwise noted in the SWPPP. A larger pit may be required depending on the frequency of use. A modification to the pit size should be noted in the SWPPP.

C. The pit shall be excavated to a depth of twelve inches (12") with 2:1 ratio slide slopes. Excavation of the pit shall conform to the provisions of Section 31 23 16, "Site Excavation."

D. The hay bales shall be installed around the perimeter of the pit in accordance with the details and at the locations shown on the SWPPP Site Map by embedding in the soil a minimum of 4 inches, or as directed by the Project Engineer or Owner's Representative. The hay bales shall be securely anchored in place by three-eighths inch (3/8") reinforcing bar stakes driven through the bale and into the existing ground as needed for stability. A minimum of two (2) stakes per bale will be observed. One stake will be angled toward the next bale to force bales together. Any remaining gaps between bales shall be filled with hay.

3.2 MAINTENANCE

A. When silt reaches a depth of six inches (6"), it shall be removed and disposed of at an approved soil disposal site.

B. The baled hay installation shall be maintained in good condition by the Contractor. All necessary work and materials to maintain the integrity of the installation shall be provided until construction operations have ceased. The area beneath the baled hay and area damaged by the maintenance process shall be repaired by the Contractor using appropriate methods as approved by the Project Engineer or Owner's Representative.

C. If the installation ceases to function as intended, the Project Engineer or Owner's Representative may direct that the installation or portions thereof be replaced.

D. After site construction is complete the bales, or silt fencing, and accumulated silt shall be removed and disposed of at an approved spoil disposal site. The pit shall be filled with suitable fill material and compacted to 95% density. The contractor shall ensure that no ponding of storm water runoff occurs by grading the area to provide positive surface drainage over and around the location of the filled pit.

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 61 16

VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for Indoor-Emissions-Restricted products.
B. Requirements for VOC-Content-Restricted products.
C. Requirement for installer certification that they did not use any non-compliant products.
D. VOC restrictions for product categories listed below under "DEFINITIONS."
E. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

1.2 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 30 00 - Administrative Requirements: Submittal procedures.
C. Section 01 40 00 - Quality Requirements: Procedures for testing and certifications.
D. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

1.3 DEFINITIONS

A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings applied on site.
   2. Interior adhesives and sealants applied on site, including flooring adhesives.
   3. Flooring.
   4. Composite wood.
   5. Products making up wall and ceiling assemblies.
   6. Thermal and acoustical insulation.
B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings applied on site.
   2. Interior adhesives and sealants applied on site, including flooring adhesives.
C. Interior of Building: Anywhere inside the exterior weather barrier.
D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
   1. Stone.
   2. Concrete.

3. Clay brick.
4. Metals that are plated, anodized, or powder-coated.
5. Glass.
6. Ceramics.
7. Solid wood flooring that is unfinished and untreated.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings 2005 (Reapproved 2018).
C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers 2017, v1.2.
D. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board current edition.
E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2007.
F. CHPS (HPPD) - High Performance Products Database Current Edition at www.chps.net/.
G. CRI (GLP) - Green Label Plus Testing Program - Certified Products Current Edition.
H. GreenSeal GS-36 - Adhesives for Commercial Use 2013.
I. SCAQMD 1113 - Architectural Coatings 1977 (Amended 2016).
J. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).
K. SCS (CPD) - SCS Certified Products Current Edition.
L. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Evidence of Compliance: Submit for each different product in each applicable category.
C. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
D. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.

1.6 QUALITY ASSURANCE

A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
   1. Wet-Applied Products: State amount applied in mass per surface area.
   2. Paints and Coatings: Test tinted products, not just tinting bases.
   3. Evidence of Compliance: Acceptable types of evidence are the following;
      a. Current UL (GGG) certification.
      b. Current SCS (CPD) Floorscore certification.

c. Current SCS (CPD) Indoor Advantage Gold certification.
d. Current listing in CHPS (HPPD) as a low-emitting product.
e. Current CRI (GLP) certification.
f. Test report showing compliance and stating exposure scenario used.

4. Product data submittal showing VOC content is NOT acceptable evidence.

B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
1. Evidence of Compliance: Acceptable types of evidence are:
a. Report of laboratory testing performed in accordance with requirements.
b. Published product data showing compliance with requirements.
c. Certification by manufacturer that product complies with requirements.

C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
1. Evidence of Compliance: Acceptable types of evidence are:
a. Current SCS "No Added Formaldehyde (NAF)" certification; www.scscertified.com.
b. Report of laboratory testing performed in accordance with requirements.
c. Published product data showing compliance with requirements.
d. Certification by manufacturer that product complies with requirements.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.1 MATERIALS

A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
2. Inherently Non-Emitting Materials.

C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
2. Aerosol Adhesives: GreenSeal GS-36.
3. Joint Sealants: SCAQMD 1168 Rule.
4. Paints and Coatings: Each color; most stringent of the following:
a. 40 CFR 59, Subpart D.
b. SCAQMD 1113 Rule.
c. CARB (SCM).

D. Paints and Coatings: Each color; most stringent of the following:
1. 40 CFR 59, Subpart D.
2. SCAQMD 1113 Rule.
3. CARB (SCM).

E. Carpet and Adhesive: Provide products having VOC content not greater than that required for CRI Green Label Plus certification.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Current Green Label Plus Certification.
      b. Report of laboratory testing performed in accordance with requirements.

F. Carpet Tile and Adhesive: Provide products having VOC content not greater than that required for CRI Green Label Plus certification.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Current Green Label Plus Certification.
      b. Report of laboratory testing performed in accordance with requirements.

G. Other Product Categories: Comply with limitations specified elsewhere.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

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 (27 deg C).
   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 01 73 29

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED WORK
- A. Division 1, General Requirements. Summary of Work.
- B. Division 23, Mechanical. Mechanical General Provisions.
- C. Division 26, Electrical. Electrical General Provisions.

1.2 DESCRIPTION
- A. Execute cutting (including excavating and backfilling), fitting or patching of the work required to:
  1. Make several parts fit properly.
  2. Uncover work to provide for installation of ill-timed work.
  3. Remove and replace defective work.
  4. Remove and replace work not conforming to requirements of the contract documents.
  5. Remove samples of installed work as specified for testing.
  6. Install specified work in existing construction.
- B. In addition to contract requirements, upon written instruction of the Engineer:
  1. Uncover work to provide for observation of covered work.
  2. Remove samples of installed materials for testing.
  3. Remove work to provide for alteration of existing work.
- C. Do not endanger any work by cutting or altering the work or any part of it.
- D. Do not cut or alter the work of another Contractor without written consent by the Engineer.
- E. Prior to cutting which affects structural safety of the project, or the work of another Contractor, secure written approval by the Engineer.

1.3 PAYMENT FOR COSTS
- A. Costs caused by ill-timed or defective work or work not conforming to the contract documents, including the cost of additional services of the Engineer, will be borne by the Contractor.
- B. Work done on written instructions of the Engineer, other than defective or non-conforming work, will be paid by the Owner.

PART 2 - PRODUCTS

Materials required for replacement of the work removed must conform to the specifications for the type of work to be done.

PART 3 - EXECUTION

3.1 PREPARATION BEFORE CUTTING
- A. Provide shoring, bracing, and support as required to maintain structural integrity of the project.
- B. Provide protection for other portions of the project.
- C. Provide protection from the elements.

3.2 PERFORMANCE
- A. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances and finishes.
- B. Execute cutting and demolition by methods which will prevent damage to other work and will prevent settlement.

C. Execute excavating and backfilling by methods which will prevent damage to other work and will prevent settlement.
D. Restore work which has been cut or removed and install new products to provide completed work in accord with requirements of the contract documents.
E. Refinish entire surfaces as necessary to provide an even finish. On continuous surfaces, refinish to the nearest intersections. For an assembly, refinish the entire item.

END OF SECTION

SECTION 01 74 00

CLEANING AND ADJUSTING

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. The Contractor is responsible for cleaning and adjusting the work. If the Contractor fails to clean and adjust the work, the Owner may do so and charge the resulting costs to the Contractor.

B. Detailed cleaning and adjusting requirements for specific trades or work are specified in sections pertaining to that trade or work.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

A. Fire Protection. Store volatile waste in covered metal containers and remove from premises daily.

B. Pollution Control. Conduct cleaning and disposal operations in compliance with local ordinances and antipollution laws.

1. Remove waste materials, rubbish, and debris from the site and legally dispose at public or private dumping areas off the project site.
2. Disposal of volatile fluid wastes and other chemical wastes in storm or sanitary sewer systems or into streams or waterways is not permitted.

C. Safety Standards. Maintain the project in accordance with safety and insurance standards.

2.0 PRODUCTS

Use only cleaning materials recommended by the manufacturer of the surface to be cleaned. Employ cleaning materials as recommended by the cleaning material manufacturer.

3.0 EXECUTION

3.1 DURING CONSTRUCTION

A. Oversee cleaning and insure that the premises are maintained free from accumulations of waste material and rubbish. Do not allow waste materials, rubbish, and debris to accumulate and become unsightly or create a hazard. Provide containers and locate on site for collection of waste material, rubbish and debris.

B. At reasonable intervals during progress of the work, collect and dispose of waste material, rubbish, and debris. Handle waste in a controlled manner. Do not drop or throw materials from heights.

3.2 FINAL CLEANING AND ADJUSTING

A. Use experienced workmen or professional cleaners for final cleaning.

B. Remove grease, dust, dirt, stains, paint, oil, labels, fingerprints, and other foreign materials from interior and exterior surfaces. Repair, patch, and touch-up marred surfaces to match adjacent finishes.

C. Broom clean paved surfaces; rake clean other surfaces of grounds.

D. If installed features of the work fail to operate or operate improperly, make the necessary adjustments to permit and insure proper operation. Remove and repair or replace maladjusted items if necessary for proper adjustment.

E. Remove all waste material and rubbish from the project area, as well as all tools, construction equipment, machinery, surplus materials, and temporary facilities.

F. Immediately prior to acceptance or occupancy, conduct a final inspection of exposed interior and exterior surfaces to verify that the work is properly cleaned. Maintain cleaning until the premises are occupied by the Owner.

3.3 ADJACENT AREAS

To the Owner's satisfaction, clean or repair adjacent areas affected by the construction. Remove dust and debris in the adjacent area. Repair, patch, and touch-up marred surfaces to match adjacent finishes.

END OF SECTION

SECTION 01 74 19

WASTE MATERIAL DISPOSAL

PART 1 - GENERAL

1.1 DESCRIPTION

Waste material disposal consists of disposal of trees, stumps, logs, brush, roots, grass, vegetation, humus, rubbish and other objectionable matter from operations such as clearing and grubbing, excavation and grading. Unless otherwise specified, the Contractor is responsible for removal and disposal of waste material.

1.2 PAYMENT

No separate payment will be made. Include cost of work in contract bid prices.

PART 2 - PRODUCTS

A. Specific products are not required. Use equipment and materials necessary to properly complete disposal of waste materials.
B. Obtain approval for equipment and materials before beginning disposal of waste materials.

3.0 EXECUTION

All waste material becomes the property of the Contractor and is to be removed from the worksite and legally disposed of in a manner not to damage the Owner. All rules of the Texas Commission on Environmental Quality, Texas Air Control Board, and U.S. Environmental Protection Agency shall be followed in the disposal of waste material.

If regulations require, provide "cradle-to-grave" documentation of the disposal including manifests.

END OF SECTION

SECTION 02 41 13

SITE DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION

This item shall govern all demolition practices for existing structures, utilities, below grade construction, and salvaging as shown on the plans or as directed by the engineer or the owner's representative.

1.2 SUMMARY

A. This Section includes the following:
   1. Demolition and removal of site improvements.
   2. Removing below-grade construction.
   3. Disconnecting, capping or sealing, and removing site utilities.
   4. Salvaging items for reuse by Owner.

B. Related Sections include the following:
   1. "Temporary Erosion Controls" Section 01 57 13 for temporary construction, protection facilities, and environmental-protection measures for building demolition operations.
   2. "Clearing and Grubbing" Section 31 11 00 for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.3 DEFINITIONS

A. Demolish: Completely remove and legally dispose of off-site.
B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.
C. Salvage: Carefully detach 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 SUBMITTALS

A. Proposed Protection Measures: Include drawings that indicate proposed protection for individuals and property, for environmental protection for dust control and, for noise control.
   1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.

B. 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 or re-routing of utility services.

C. Building Demolition Plans: Drawings indicating the following:
   1. Locations of temporary protection and means of egress for adjacent occupied buildings.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by building demolition operations.

F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

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 A10.6 and NFPA 241.
C. Pre-demolition Conference: Conduct conference at Project site with the civil engineer or owner's representative. Review methods and procedures related to building demolition including, but not limited to, the following:
   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.

1.7 PROJECT CONDITIONS

A. Facilities to be demolished will be vacated and their use discontinued before start of the Work.
B. Owner assumes no responsibility for facilities and structures to be demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
C. On-site storage or sale of removed items or materials is not permitted.

1.8 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 31 22 00 "Grading."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.
B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
C. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
   1. Owner will arrange to shut off indicated utilities when requested by Contractor.
   2. Arrange to shut off indicated 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 6 inches (153 mm) below subgrade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

B. Existing Utilities: Refer to Divisions 33 for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of demolition.

D. 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 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: 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.
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. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. 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.

3.4 DEMOLITION, GENERAL

A. General: Demolish indicated existing facilities 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 fire watch during and after flame cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from facility demolition activities.

C. Site Access and Temporary Controls: Conduct facility 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 traffic ways 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.

D. Explosives: Use of explosives is not permitted.

3.5 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level.

B. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet (1.5 m) outside footprint indicated for new construction. Abandon below-grade construction outside this area.
1. Remove below-grade construction, including basements, foundation walls, and footings, to at least 24 inches (600 mm) below grade or 6 inches (153 mm) below subgrade.

C. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut and excavate to a minimum of 6 inches (153 mm) below finished subgrade.

D. Existing Utilities: Demolish all existing utilities and below-grade utility structures that are present on site.
1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Section 31 23 23 "Subgrade Fill."
2. Piping: Disconnect piping at unions, flanges, valves, or fittings.
3. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.6 DEMOLITION BY EXPLOSIVES

A. Explosives: Use of explosives not permitted.

3.7 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 31 23 23 "Subgrade Fill."

C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.
B. Promptly replace or repair damage to existing utilities that are to remain.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose or recycle demolition waste.
B. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved 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.
C. 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.

END OF SECTION

SECTION 03 11 00

CIVIL CONCRETE FORMWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section defines requirements and limitations for design, construction, erection, and removal of concrete formwork for this project.

1.2 REFERENCE STANDARD

A. American Concrete Institute; ACI 347, "Recommended Practice for Concrete Formwork."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms for As-Cast Finish
   1. Rough Form Finish. Dressed or undressed lumber free of knots, splits, or other defects; plywood; metal; other approved material.
   2. Smooth Form Finish. Plywood, tempered, concrete-form hardboard; dressed lumber faced with plywood; metal; plastic; other approved material. Do not use material with raised grain, torn surface, work edges, patches, dents, or other defects.

B. Form Accessories
   1. Use commercially manufactured ties, hangers, and other accessories for embedding in concrete. Use of wire which is not commercially fabricated as form accessories is not permitted.
   2. Install form ties so that ends or end fasteners can be removed without causing spalling of concrete faces.
   3. When formed concrete face will not be permanently exposed to view, form ties may be cut flush with formed surfaces.
   4. When formed concrete face will be exposed to view and after ends or end fasteners of form ties have been removed, the embedded portion must be at least ¾-inch (¾") or twice the minimum dimension of the tie from formed concrete faces.

C. Form Coating. Use commercial formulation of form oil or form-release agent having proven satisfactory performance. Coating must not bond with, stain, or adversely effect concrete surfaces. It must not impair subsequent treatment of concrete surfaces, including bonding agents and curing compounds.

D. Chamfer Strips. Provide in corners of forms to produce beveled edges on permanently exposed surfaces. Size of chamfer is ¾-inch (¾") unless shown otherwise. Interior corners and edges of formed joints do not require beveling unless otherwise shown.

2.2 DESIGN OF FORMWORK

Design formwork for loads, lateral pressure, and allowable stresses as described in the reference standard (ACI 347). Allow for design consideration, wind loads, allowable stresses, and other applicable requirements of controlling local building codes.

A. Tolerances.
   1. For concrete surfaces exposed to view, the maximum allowable deflection is 1/240 of the span between structural members.
   2. When necessary to maintain specified tolerances, chamfer formwork to compensate for anticipated deflection during concrete hardening.
   3. Design forms sufficiently tight to prevent loss of mortar.

B. Earth Cuts for Forms. For beams under slabs on grade, use earth cuts for forms where beams are shown to have sloping sides and are integral with slab. Earth cuts may be used for sides of footings if sides of excavation are in stable condition to prevent caving or sloughing.
C. Slip Forming. Not permitted.

PART 3 - EXECUTION

3.1 NOTIFICATION

At least 24 hours prior to scheduled concrete placement, notify the Engineer that formwork may be inspected. Do not place concrete until forms have been inspected and approved.

3.2 PREPARATION

A. Anchor, brace, and tie formwork to shores, members, or other supporting surfaces to prevent upward or lateral movement to any part of formwork system during concrete placement. Tighten forms to close joints and insure conformance to specified lines and shapes. Remove and rebuild forms that cannot be tightened properly.
B. Arrange facing material in an orderly and symmetrical fashion. Keep the number of seams to a practical minimum. Support facing material adequately to prevent deflection in excess of specified tolerances.
C. For flush surfaces exposed to view, overlap previously placed, hardened concrete with form sheeting by approximately one-inch (1"). Hold forms against hardened concrete to maintain true surfaces, preventing offsets or loss of mortar.
D. Provide temporary openings at the base of column and wall forms and at other points required. The openings facilitate observation and cleaning immediately before concrete is placed.
E. If runways are required for moving equipment, provide for support of runways with struts or legs resting directly on the formwork or structural member. Do not allow runways or supports to rest on reinforcing steel.

3.3 ADJUSTMENTS

A. Use wedges or jacks to provide positive adjustment of shores and struts. Wedges used for final adjustment of forms should be fastened in position after final inspection and before concrete placement.
B. Securely brace forms against lateral deflections. Prepare to compensate for settling during concrete placement.
C. For wall openings, construct wood forms that facilitate any necessary loosening to counteract swelling of forms.

3.4 TOLERANCES

A. Construct formwork so that concrete surfaces will conform to tolerance limits as listed in the appropriate table at the end of this section.
B. Establish sufficient control points and benchmarks as references for tolerance checks. Maintain these references in undisturbed condition until final completion and acceptance of the project.

3.5 PREPARATION OF FORM SURFACES

A. Before placing concrete, clean surfaces of forms and embedded materials. Remove accumulated mortar, grout, rust and other foreign matter.
B. Coat forms for exposed or painted concrete surfaces with form oil or form-release agent before placing reinforcement. Cover form surfaces with coating material used in strict accordance with the manufacturer's printed instructions. Do not allow excess coating material to accumulate in forms or to contact hardened concrete against which fresh concrete will be placed. Remove coating material from reinforcement before placing concrete.

C. Other than retained-in-place metal forms, forms for unexposed surfaces may be wet with water immediately before concrete placement in lieu of coating. One exception is that when a possibility of freezing temperatures exists, use of a coating is mandatory.

3.6 REMOVAL OF FORMS

A. On vertical surfaces when repair of surfaces defects or finishing is required before concrete is aged, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.

B. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed after 12 hours provided that concrete has hardened sufficiently to resist damage from removal operations. When shores and other vertical supports are arranged so that nonload-carrying, form-facing material may be removed without loosening or disturbing shores and supports, facing material may be removed at an earlier age.

C. Keep in place all forms and shoring used to support weight of concrete until concrete has reached the minimum strength specified for removal of forms and shoring. In no case shall forms be removed in less than four (4) days.

3.7 REMOVAL STRENGTH

A. Control Tests. Suitable strength control tests will be used as evidence that concrete has attained specified strength for removal of formwork or shoring supporting weight of concrete in beams, slabs, and other structural members.

1. Field Test. When field cured test cylinders reach the specified removal strength, formwork or shoring may be removed from the respective concrete placements.
2. Laboratory Test. When concrete has been cured as specified for cast-in-place concrete for the same time period required by laboratory cured cylinders to reach specified strength, the formwork or shoring may be removed from respective concrete placements. Determine the length of time that the concrete placement has been cured by totaling the number of days or fraction of days, not necessarily consecutive, during which the air temperature surrounding the concrete is above 50□F and the concrete has been damp or thoroughly sealed against evaporation and loss of moisture.

B. Compressive Strengths. The minimum concrete compressive strengths for removal of all formwork not specifically covered under the previous paragraph on Removal of Forms shall be 75 percent (75%) of the specified minimum 28-day strength of the class of concrete involved.

3.8 SHORING

A. When reshoring is permitted or required, plan operations in advance and secure approval of such operations. While reshoring is under way, keep live load off the new construction. Do not permit concrete in beam, slab, column or other structural member to be subjected to combined dead and construction loads in excess of loads permitted for developed concrete strength at the time of reshoring.

B. Place reshores as soon as practicable after stripping operations are complete but in no case later than the end of the working day on which stripping occurs. Tighten reshores to carry the required loads without overstressing construction. Leave reshores in place until tests representative of concrete being supported have reached specified strength or strength specified for removal of reshores.

C. Leave original supporting shores in place or reshore those floors supporting shoring under newly placed concrete. Reshoring system capacity must be sufficient to resist anticipated loads and in all cases have a capacity equal to at least ½ of the capacity of the shoring system

above. Locate reshores directly under shore positions above unless other locations are permitted.

D. Extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms and construction live loads in such a manner that design superimposed loads of floors supporting shores are not exceeded.

3.9 FORM REUSE

Approval is required before reusing any forms. Do not reuse forms that are worn or damaged beyond repair. Thoroughly clean and recoat forms before reuse. For wood and plywood forms to be used for exposed smooth finish, sand or otherwise dress concrete contact surface to original condition or provide form liner facing material. For metal forms, straighten, remove dents and clean to return to original condition.

TABLE 3A
TOLERANCES FOR FORMED SURFACES
CONCRETE IN BUILDINGS

Variation Form	Variation in	For Any 10 Foot Length	For Any 20 Foot Length or Any Bay	Maximum For Entire Dimension
Plumb or Specified Batter	Lines and surfaces of columns, piers, walls, and arrises	¼"	--	1"
	Exposed corner columns, control joint grooves, and other conspicuous lines	¼"	¼"	½"
Level or Specified Grade	Slab soffits, ceilings, beam soffits, and in arrises (measured before removal of shores)	¼"	_"	¾"
	exposed lintels, sills, parapets horizontal grooves and other conspicuous lines	--	¼"	½"
Drawing Dimensions	Position of linear building lines, columns, walls, and partitions	--	½"	1"
	Size and location of sleeves, floor openings and wall openings	--	--	±¼"
	Cross section of columns, beams, slabs, and walls	--	--	+½" -¼"
	Footings* in plan	--	--	+2" -½"
	Footing misplacement or eccentricity of direction error (the less of)	--	--	2% of width or 2"
	Footing thickness decrease	--	--	5%
	Footing thickness increase	--	--	no limit
	Step rise in flight of stairs	--	--	±_"
	Step tread in flight of stairs	--	--	±¼"
	Consecutive step rise	--	--	$\pm 1/16$"
	Consecutive step tread	--	--	±_"

* Footing tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.

TABLE 3B
TOLERANCES FOR FORMED SURFACES
CONCRETE IN BRIDGES, WHARVES AND SIMILAR STRUCTURES

Variation Form	Variation In	Maximum
Plumb or Specified Batter	Surfaces of Columns, Piers, and Walls	½" in 10_
Level or Specified Grade	Top Surfaces of Slabs, Curbs, & Railings	$^{3}/_{16}$" in 10_
Drawings Dimensions	Cross Section of Columns, Caps, Beams and Similar Members	+½" -¼"
	Thickness of Deck Slabs	+¼" -_"
	Footing	*

* Same as footings for buildings - See Table 3A.

END OF SECTION

SECTION 03 15 00

CIVIL CONCRETE JOINTS AND EMBEDDED ITEMS

PART 1 - GENERAL

1.1 SCOPE

This section specifies requirements for construction joints, contraction joints, expansion joints and embedded items for concrete work. Coordinate work of this section with related work of other sections to obtain a proper installation. Review drawings and specifications for additional requirements for joints and embedded items.

1.2 REFERENCE STANDARDS

The latest editions of reference standards listed below form a part of this specification and are applicable to this project.

A. American Society for Testing and Materials (ASTM).
   1. ASTM A-120, "Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses."
   2. ASTM A-306, "Carbon Steel Bars Subject to Mechanical Property Requirements."
   3. ASTM D-994, "Preformed Expansion Joint Filler for Concrete (Bituminous Type)."
   4. ASTM D-1751, "Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextending and Resilient Bituminous Types)."
   5. ASTM D-1752, "Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction."

1.3 SUBMITTALS

A. Shop Drawings. Submit shop drawings as specified in Division 1 - General Requirements. Shop drawings shall show expansion joints, construction joints and sequences for concrete placement.

B. Substitute Materials. Acceptable brands of materials are specified herein. If substitutions are desired, submit brochures and samples of requested substitutions for approval before delivery to the project.

PART 2 - PRODUCTS

A. Expansion Joint Filler, Nonbituminous. Preformed cork filler conforming to ASTM D-1752 or plain fillerboard conforming to ASTM D-1751. Use ¾-inch (¾") thickness unless otherwise shown on the drawings.

B. Expansion Joint Sealer. Polysulfide compound conforming to ANSI 116.1. Acceptable products include:
   1. Cork filler such as Sonneborn's "Sonoflex Cork" or Grace's "Standard Cork" Code 4323.
   2. Grace's "Verti-seal" (Thiokol two-component Polysulfide Sealant) #2382 or Sonneborn's "Sonolastic" (Two Part) (Code CS 311).
   3. Or approved equal.

C. Bonding Agent. A. C. Horn Products, "Thiopoxy 62"; Sika Corporation, "Sikadur 32 Hi-Mod"; or Permagile Corporation, "Uniweld"; or approved equal.

D. Bond Breaker. 30-pound asphalt saturated felt.

E. Expansion Joint Dowels. Plain steel bars conforming to ASTM A-306, grade 70. Cut dowels to length at shop or mill before delivery to the site. Dowels must be straight and clean, free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04-inches from the end.

F. Sleeves. ASTM A-120, standard weight galvanized pipe.

G. Waterstops. Use polyvinylchloride waterstops as manufactured by Tiger Indus-tries; W. R. Meadows, Inc.; W. R. Grace & Company; or approved equal. Unless otherwise shown, use stops of six-inch (6") minimum width and $^{3}/_{16}$-inch ($^{3}/_{16}$") minimum thickness, similar in construction to "Tiger-Flex," Type SB, standard ribbed with bulb.

PART 3 - EXECUTION

3.1 PLACEMENT OF EMBEDDED ITEMS

A. Place embedded items to least impair strength of the structure. Obtain approval of locations for embedded items before placement of concrete. Should locations of embedded items conflict with reinforcement or be detrimental to strength of structure, relocate items as directed.

B. Do not cut or reposition reinforcing steel to facilitate installation of inserts, conduit, sleeves, anchor bolts, mechanical openings and similar items without prior approval.

3.2 CONSTRUCTION JOINTS

A. Make construction joints only at locations shown on reviewed shop drawings or as directed. Comply with the following procedures unless exceptions are shown on the drawings or deviations are specifically directed by the Engineer.

B. Joints not shown on drawings must be approved. Locate joints to least impair strength of the structure. In general, locate joints near the middle of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset joints in girders a distance equal to twice the width of the beam. Locate joints in walls and columns at the underside of floors, slabs, beams and girders and at tops of footings or floor slabs. Place beams, girders, brackets, column capitals, haunches and drop panels monolithic with slabs.

C. Place all joints perpendicular to main reinforcement. Continue all reinforcing steel and mesh across construction joints. Provide keys as directed. Provide longitudinal keys at least 1½-inch (1½") deep by 1/3 of the wall thickness, centered in the wall, in all joints in walls.

D. Prepare joints by roughening the concrete surface in an approved manner which will expose aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at surface.

E. Filler must be full depth of concrete section with top held down ¾-inch (¾") to provide recess for sealant. Polysulfide sealer shall be used on all interior expansion joints and paving.

F. In lieu of the above method for securing bond between new and set concrete, the following optional method may be used. Use a bonding agent applied to roughened and cleaned surfaces of set concrete in strict accordance with manufacturer's recommendations with respect to preparation of surfaces and applications of bond agent.

3.3 WATERSTOPS

A. Install in locations shown.

B. Each piece of premolded water stop must be of maximum practicable length for a minimum number of end joints.

C. Make joints at intersections and at ends of pieces in a manner most appropriate to the material being used and in accordance with manufacturer's recommendations. Joints must develop effective watertightness fully equal to that of continuous waterstop material, must permanently develop not less than 50 percent (50%) of mechanical strength of parent section, and must permanently retain flexibility.

D. Accurately position and support waterstops against displacement during concrete placement.

3.4 OTHER EMBEDDED ITEMS

A. It is the Contractor's responsibility to check shop drawings for number and location of embedded items and that work is coordinated so that embedded items are properly placed.

B. Accurately position and support embedded items against displacement during concrete placement.

C. Metal items, except reinforcing, must be galvanized unless specific exception is obtained.

END OF SECTION

SECTION 03 20 00

CIVIL CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SCOPE

This section gives requirements for concrete reinforcement. Coordinate the requirements of this section with all other sections of Division 3 - Concrete.

1.2 REFERENCE STANDARDS

The latest editions of reference standards listed below form a part of this specification and are applicable to this project.

A. American Society for Testing and Materials.
   1. ASTM A-615, "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"
   2. ASTM A-185, "Specification for Welded Steel Wire Fabric for Concrete Reinforcement"
   3. ASTM A-306, "Specification for Carbon Steel Bars Subject to Mechanical Property Requirements"

B. American Concrete Institute.
   1. ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures"
   2. ACI 318, "Building Code Requirements for Reinforced Concrete"

C. Concrete Reinforcing Steel Institute.
   1. CRSI 163, "Recommended Practice for Placing Reinforcing Bars"
   2. CRSI 165, "Recommended Practice for Placing Bar Supports, Specifications and Nomenclature"

1.3 SUBMITTALS

A. Certificates. Submit the manufacturer's certificates giving the properties of steel proposed for use. List the manufacturer's test number and heat number, chemical analysis, yield point, tensile strength and percent elongation. Also identify on the certificates the proposed location of the steel in the work.

B. Bill of Materials. Submit bills of materials to be reviewed with shop drawings.

C. Shop Drawings.
   1. Submit shop drawings according to Division 1, General Requirements. Show reinforcement fabrication, bar placement location, splices, spacing, and bar designation, bar type, length, size, bending, number of bars, location of bars to accommodate post-tensioning tendons and other pertinent information, including dimensions. Information must correspond directly to data listed on the bill of material.
   2. Provide sufficient detail to permit placement of reinforcement without use of design drawings. Reproduction of design drawings for use as shop drawings will not be allowed. Begin fabrication of reinforcing steel after shop drawings have been reviewed by the Engineer.
   3. Refer to ACI reference standards for detailing, location, placing, splicing, etc. of reinforcing steel to be shown on shop drawings.

1.4 SCHEDULING

Schedule materials for delivery to the site so that items may be installed immediately upon delivery. Plan the schedule to accommodate other work, especially post-tensioning. Place items in the proper sequence so that removal and replacement to accommodate other work is avoided.

1.5 HANDLING AND STORAGE

Store steel reinforcement above the ground on platforms, skids or other supports. Protect reinforcing, as far as practicable, from mechanical injury, surface deterioration and rusting caused by exposure to the weather.

1.6 INSPECTION

Make storage and fabrication facilities of the supplier and fabricator available for inspection by the Engineer prior to and during fabrication.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Deformed Bars. Use deformed bars conforming to ASTM A-615, grade as specified on drawings, for all bars except column spirals and those shown on drawings to be smooth bars. Where grade is not specified on drawings, use Grade 60.
B. Smooth Bars. Use bars conforming to ASTM A-306, Grade 70, for all smooth bars including column spirals.
C. Marking. Clearly mark all bars with waterproof tags showing the number of bars, size, mark, length and yield strength. Mark steel with the same designation as the member in which it occurs. Key marks to the concrete placement number as designated in the concrete placement sequence shown on the drawings.
D. Welded Wire Fabric. ASTM A-185, electrically-welded wire fabric of cold-drawn wire. Provide gauge and mesh size as shown.

2.2 MECHANICAL BAR SPLICES

A. G-Loc Splices. As manufactured by Gateway Building Products, 3233 W. Grand Avenue, Chicago, Illinois, or approved equal.
B. Cadweld Splices. As manufactured by Erico Products, Inc., 2070 E. 61st Place, Cleveland, Ohio, or approved equal.

2.3 TIE WIRE

Use 18-gage annealed steel for tie wire.

2.4 ACCESSORIES

Provide chairs, riser bars, ties and other accessories made of plastic or metal, except as otherwise specified. Where concrete surfaces are exposed to the weather in finished work, provide plastic or plastic-coated accessories only. Use of galvanized accessories is not permitted in these locations. Use plastic accessories manufactured by W.H.C. Products, Inc., Houston, Texas or approved equal.

PART 3 - EXECUTION

3.1 NOTIFICATION

Notify the Engineer at least 24-hours before concrete placement so that reinforcement may be inspected and errors corrected without delaying the work.

3.2 FABRICATION

A. Bending. Fabricate reinforcing steel bars as prescribed in the CRSI Manual of Standard Practice to the shapes and dimensions shown on the plans. Fabricate in the shop if possible. Field-fabricate, if permitted, using a method approved by the Engineer. Replace improperly fabricated, damaged, or broken bars at no additional expense. Do not straighten or rebend bars without specific approval. On the job, cut bars by shearing or sawing.
B. Splices. Use a minimum number of splices. Lap splices in strict accord with ACI 318 or as shown. Splices not shown on the plans will be permitted in slabs no more than 15 in. in thickness, columns, walls, and parapets. Where it is necessary to splice reinforcement other

than as shown, the Engineer will determine the character of the splice. Do not make splices at points of maximum stress. Stagger splices in adjacent bars. For additional splicing guidelines reference TxDOT Standard Specifications, Item 440, "Reinforcement for Concrete".

C. Fabrication Tolerances. Bars used for concrete reinforcement must conform to the following fabrication tolerances.

Measurement	Tolerance in Inches
Sheared length	± 1
Depth of truss bars to 8-inch depth	± 0, - ¼
Depth of truss bars over 8-inch depth	+ 0, - ½
Stirrups, ties and spirals	± ¼
All other bends	± 1

3.3 PLACING

A. Condition of Reinforcement. Reinforcement must be free of injurious seams, flaws, cracks, scale, loose or flaky rust or other foreign material, including oil, mud or coating that will reduce the bond to concrete.

B. Placement Tolerances. Place reinforcement within the following tolerances.

a.

Placement	Tolerance in Inches
Concrete cover to formed surfaces	± ¼
Minimum spacing between bars	± ¼
Top bars in slabs and beams to 8-inch depth	± ¼
Top bars in slabs and beams between 8 and 24-inch depth	± ½
Top bars in slabs and beams more than 24 inches in depth	± 1
Crosswise of members spaced evenly within	± 2
Lengthwise of members	± 2

C. Concrete Cover. Except as otherwise shown, provide a clear cover measured from reinforcement to the face of the concrete as listed.

Surfaces	Measurement in Inches
Interior not exposed to weather	
Slabs, joists, and walls	¾
Beams, girders, and columns	1½
Exterior not in contact with earth or water	
Slabs and walls, No. 6 and smaller bars	1
Slabs and walls, No. 7 and larger bars	1½
Beams, girders, and columns	2
Exterior in contact with earth or fresh water	
Slabs and walls, No. 6 and smaller bars	1½
Slabs and walls, No. 7 and larger bars	2
Beams, girders, and columns	2½
Exposed to salt water or salt spray	
Slabs and walls	2
Beams, girders, and columns	3
Footings	
Top and sides	2
Bottom	3
Increase measurements under these conditions:	
Cover of top bars for slabs without wearing surface designed to carry vehicular traffic	½
When using No. 14 or No. 18 bars	½

3.4 ASSEMBLY

A. Reinforcing Bars in Forms Use spacers, chairs, wire ties and other accessory items necessary to properly assemble, space and support reinforcing. Provide accessories of sufficient number, size and strength to adequately prevent deflection or displacement of reinforcement due to construction loads or concrete placement. Accessories recommended by CRSI will be used if not otherwise specified or shown. Accessories shall be of a size to provide concrete cover as previously specified. Use appropriate accessories to position and support bolts, anchors and other embedded items. Tie reinforcing bars at each intersection and to accessories. Blocking reinforcement upon concrete or masonry is prohibited.

B. Reinforcement for Concrete on Ground. Support reinforcement on plastic chairs spaced about three-feet (3") on center each way. Use a minimum of one (1) chair for each nine (9) square feet. Fasten chairs to the reinforcement as recommended by the manufacturer of the chairs.

C. Vertical Reinforcement in Columns. Offset vertical bars by at least one (1) bar diameter at splices. Provide accurate templates for column dowels to insure proper placement.

D. Mechanical Bar Splices. Use only where indicated.

E. Welded Wire Fabric.

1. For welded wire fabric designated as load carrying reinforcement, make lapped splices so that the overlap measured between the outer-most cross wires of each fabric sheet is not less than the spacing of cross wires plus two-inches (2"). Support as required for reinforcing bars.
2. For welded wire fabric not specifically designated as load carrying reinforcement, make lapped splices so that the overlap measured between the outermost cross wires of each fabric sheet is not less than two-inches (2"). Extend the fabric across supporting beams

and walls to within four-inches (4") of concrete edges. Also extend the fabric through contraction joints and construction joints, other than keyed joints in slabs on the ground.

F. Construction Joints. Provide continuous reinforcing through joints. As a general rule, place unscheduled joints at midspan. Obtain specific approval for jointing and bar splicing that is not indicated on the drawings. Splices shown on reviewed shop drawings are acceptable.

G. Interferences. If reinforcing interferes with the location of other reinforcing steel, conduits or embedded items, request instructions from the Engineer. The Engineer need not be notified if bars are moved to avoid such interferences unless the bars are moved more than one (1) bar diameter or enough to exceed specified tolerances. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without approval.

H. Field Bending. Shape reinforcing bent during construction operations to conform to the drawings. Closely inspect the reinforcing for breaks. If reinforcing is damaged, replace, cadweld, or otherwise repair as directed. Do not bend reinforcement after it is embedded in concrete.

I. Welding. Unless directed by the Engineer, do not weld reinforcing bars.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.
   5. Drilled Piers

1.3 WORK INCLUDED

A. Design, fabrication, erection, and stripping of formwork for cast-in-place concrete including shoring, reshoring, falsework, bracing, proprietary forming systems, prefabricated forms, void forms, permanent metal forms, bulkheads, keys, blockouts, sleeves, pockets, and accessories. Erection shall include installation in formwork of items furnished by other trades.

B. Furnish all labor and materials required to fabricate, deliver and install reinforcement and embedded metal assemblies for cast-in-place concrete, including steel bars, welded steel wire fabric, ties and supports.

C. Furnish all labor and materials required to perform the following:
   1. Cast-in-place concrete
   2. Concrete mix designs
   3. Concrete for drilled piers

D. Related Sections include the following:
   1. Division 31 Section “Drilled Piers” for drilled concrete piers.
   2. Division 32 Section “Concrete Pavement” for concrete pavement and walks.

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, Slag Cement, and silica fume; subject to compliance with requirements.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture, submit proposed mix designs in accordance with ACI 318 requirements. Each proposed mix design shall be accompanied by a record of past performance.

1. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
2. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
   1. Do not reproduce the structural drawings for use as shop drawings.
   2. Embedded metal assemblies: Submit shop drawings for fabrication and placement. Use standard AWS welding symbols.

D. Steel Reinforcement Submittals for Information: Mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

E. Welding certificates.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates.

G. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials
   2. Admixtures
   3. Form materials and form-release agents
   4. Steel reinforcement and accessories
   5. Waterstops
   6. Curing compounds
   7. Floor and slab treatments
   8. Bonding agents
   9. Adhesives
   10. Vapor retarders
   11. Joint-filler strips
   12. Repair materials

H. Submit manufacturer's certification of maximum chloride ion content in admixtures.

I. Fly ash: Submit certification attesting to carbon content and compliance with ASTM C618.

J. Construction Joint Layout: Submit a diagram of proposed construction joint locations for horizontal framing that exceed the limits of a single placement as stated in the structural notes, other than those indicated on the Drawings.

K. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

L. Field quality-control test and inspection reports.

M. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specification for Structural Concrete,"
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Owner may engage a qualified independent testing agency to perform material evaluation tests.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
C. Store all proprietary materials in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301 (ACI 301M).
   2. ACI 117 (ACI 117M).

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. High-density overlay, Class 1 or better.
   3. Steel Forms
B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
D. Void Forms: Shall be the product of a reputable manufacturer regularly engaged in the commercial production of void forms.
   1. Void form composition shall be of corrugated paper material with a moisture resistant exterior and an interior fabrication of a uniform cellular configuration, composed of components constructed of double-faced wax-impregnated (partially or fully), corrugated fiberboard that is laminated with moisture resistant adhesive.
   2. Design and maintain void forms to support all vertical and lateral loads that might be applied during construction until such loads can be supported by the concrete structure.
   3. Form material shall be designed to lose its strength under prolonged contact with the moisture which normally accumulates beneath slabs and beams on grade.
E. Protection Board: For use over void forms under structural slabs. Hard-pressed cellulose fiber board, 1/8 inch minimum thickness.
F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

J. Soil Retainers: Shall be provided where specified and shown on the drawings to prevent migration of backfill under suspended foundation elements:
   1. Retainers shall be composed of high density polypropylene materials that are not adversely affected by moisture. They must be flexible, impact resistant and have sufficient strength to resist lateral loads applied by soil.
      a. Thickness: As specified.
      b. Soil retainers shall extend six inches above the void forms and a minimum of 3 inches below the void forms.

2.3 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Deformed-Bar Anchor: ASTM A1064/ A1064M.

E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2. For slabs on grade and slabs on void forms, provide sand plates, horizontal runners, or precast concrete blocks on bottom where base material will not support chair legs or where vapor barrier has been specified.

2.5 MECHANICAL SPLICES

A. Provide mechanical splices designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the smaller bar being spliced. The following splicing systems are acceptable:
   1. Erico "Cadweld T-Series"
   2. Erico "Lenton"
   3. Dayton Barsplice "Bar-Grip"
   4. Dayton Barsplice "Grip-Twist"

2.6 DOWEL BAR ANCHORS

A. Provide dowel bar anchors and threaded dowels designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the dowel bars. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by the anchor supplier. The following dowel splicing systems are acceptable:
   1. Richmond Screw Anchor "Dowel Bar Splicer"
   2. Erico "Lenton Form Saver"
   3. Dayton Barsplice "Grip-Twist"

2.7 EMBEDDED METAL ASSEMBLIES

A. Steel Shapes and Plates: ASTM A36
B. Headed Studs: Heads welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division.
C. Welded Deformed Bar Anchors: ASTM A1064/ A1064M: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
D. Reinforcing Bars to be Welded: ASTM A706.
E. Coatings
   1. Hot dip galvanizing shall conform to ASTM A123, "Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products."
   2. Cold Galvanizing Compound for field repair of galvanizing: "ZRC Cold Galvanizing Compound" by ZRC Chemical Products Company, Quincy, Massachusetts.

2.8 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C.
      b. Slag Cement: ASTM C 989, Grade 100 or 120.
B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
   1. Maximum Coarse-Aggregate Size: As indicated on drawings.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 1602/C 1602M and potable.

2.9 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.10 WATERSTOPS

A. Waterstops: At all construction joints below grade. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

B. Products:

C. Carlise Coatings & Waterproofing, Inc.; MiraSTOP.

D. CETCO; Volclay Waterstop-RX.

E. Concrete Sealants Inc.; Conseal CS-231.

F. Greenstreak; Swellstop.

G. Henry Company, Sealants Division; Hydro-Flex.

2.11 VAPOR BARRIERS

A. Plastic Vapor Barrier: ASTM E 1745, Class A.
   1. Membrane shall have the following properties:
      a. Minimum 15 mils thickness.
      b. Permeance Rating: ASTM E 96, 0.03 Perms [grains/(ft^2 * hr *- in Hg)] or lower as tested after mandatory conditioning (ASTM E 154 sections 8, 11, 12, 13)
      c. Installation shall be in accordance with ASTM E 1643 and manufacturer's instructions.
   2. Products:
      a. Epro; Ecoshield-E 15 mi.
      b. Fortifiber Building Systems Group; Moistop Ultra 15.
      c. Inteplast Group; Barrier Bac VB-250 Vapor Retarder, 15 mil.
      d. Insulation Solutions, Inc. Viper VaporCheck II 15.
      e. Raven Industries Inc. Vapor Block 15.

f. Reef Industries, Inc.; Griffolyn 15 mil Green.
g. Stego Wrap 15 mil, by Stego.
h. W.R. Meadows, Inc. Perminator 15 mil.

3. Accessories
   a. Perimeter/seam sealing detail tape:
      1) Crete-Claw detail tape by Stego Industries, LLC, for adhering vapor retarder membrane to the underside of concrete surface at slabs on carton void forms, 3-inch and 6-inch widths as noted in Part 3.
      2) StegoTack double sided adhesive tape by Stego Industries, LLC, for adhering vapor retarder membrane to concrete at gradebeams.
   b. Manufacturer's recommended standard adhesive or pressure sensitive tape for general use

2.12 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Products:
      a. Axim Concrete Technologies; CATEXOL Cimfilm.
      b. BASF Construction Chemicals – Building Systems; Confilm.
      c. ChemMasters; Spray-Film.
      d. Conspec by Dayton Superior; Aquafilm.
      e. Dayton Superior Corporation; Sure Film (J-74).
      f. Edoco by Dayton Superior; BurkeFilm.
      g. Euclid Chemical Company (The), an RPM company; Eucobar.
      h. Kaufman Products, Inc.; Vapor Aid.
      i. Lambert Corporation; LAMBCO Skin.
      j. L&M Construction Chemicals, Inc.; E-Con.
      k. Meadows, W. R., Inc.; EVAPRE.
      l. Metalcrete Industries; Waterhold.
      m. Nox-Crete Products Group; Monofilm.
      n. Sika Corporation, Inc.; SikaFilm.
      o. SpecChem, LLC; Spec Film.
      p. Symons by Dayton Superior; Finishing Aid.
      q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
      r. Unitex; Pro-Film.
      s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products:
    a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    b. BASF Construction Chemicals – Building Systems; Kure 200.
    c. ChemMasters; Safe-Cure Clear.
    d. Conspec by Dayton Superior; W.B. Resin Cure.
    e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
    f. Edoco by Dayton Superior; Res X Cure WB.
    g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
    h. Kaufman Products, Inc.; Thinfilm 420.
    i. Lambert Corporation; Aqua Kure-Clear.
    j. L&M Construction Chemicals, Inc.; L&M Cure R.
    k. Meadows, W. R., Inc.; 1100 Clear.
    l. Nox-Crete Products Group; Resin Cure E.
    m. Right Pointe; Clear Water Resin.
    n. SpecChem, LLC; Spec Rez Clear.
    o. Symons by Dayton Superior; Resi-Chem Clear.
    p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
    q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
    1. Products:
        a. Anti-Hydro International, Inc.; AH Clear Cure WB.
        b. BASF Construction Chemicals – Building Systems; Kure-N-Seal WB.
        c. ChemMasters; Safe-Cure & Seal 20.
        d. Conspec by Dayton Superior; Cure and Seal WB.
        e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
        f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
        g. Edoco by Dayton Superior; Spartan Cote WB II.
        h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
        i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
        j. Lambert Corporation; Glazecote Sealer-20.
        k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
        l. Meadows, W. R., Inc.; Vocomp-20.
        m. Metalcrete Industries; Metcure.
        n. Nox-Crete Products Group; Cure & Seal 150E.
        o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
        p. TK Products, Division of Sierra Corporation; TK-2519 WB.
        q. Vexcon Chemicals, Inc.; Starseal 309.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating**,** certified by curing compound manufacturer to not interfere with bonding of floor covering.
   1. Products:
      a. BASF Construction Chemicals – Building Systems; Kure-N-Seal W.
      b. ChemMasters; Safe-Cure Clear.
      c. Conspec by Dayton Superior; High Seal.
      d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
      e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
      f. Euclid Chemical Company (The), an RPM Company; Diamond Clear VOX; Clearseal WB STD.
      g. Kaufman Products, Inc.; SureCure Emulsion.
      h. Lambert Corporation; Glazecote Sealer-20.
      i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
      j. Meadows, W. R., Inc.; Vocomp-20.
      k. Metalcrete Industries; Metcure 0800.
      l. Nox-Crete Products Group; Cure & Seal 200E.
      m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
      n. Vexcon Chemicals, Inc.; Starseal 0800.

2.13 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
C. Sleeves and Blockouts: Formed with galvanized metal, galvanized pipe, polyvinyl chloride pipe, fiber tubes, or wood.
D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

2.14 REPAIR MATERIALS

A. Repair Mortar – Hand-Applied: Pre-packaged, cement-based, two-component, polymer-modified, trowel-grade mortar, enhanced with penetrating corrosion inhibitor.
   1. Compressive Strength: 1200 psi minimum at 1 day; 6000 psi minimum at 28 days when tested according to ASTM C 109.
   2. Bond Strength: 1800 psi minimum at 28 days when tested according to ASTM C 882 (Modified).
   3. Product / Manufacturer: SikaTop 122 Plus or SikaTop 123 Plus, Sika Corporation, or approved equal.
B. Repair Mortar – Form and Pour or Pump: Pre-packaged, cement-based, single-component, polymer-modified, silica-fume-enhanced, cementitious mortar.
   1. Compressive Strength: 3000 psi minimum at 1 day; 6500 psi at 28 days when tested according to ASTM C 109.
   2. Bond Strength: 2200 psi at 28 days when tested according to ASTM C 882 (modified).

3. Product / Manufacturer: Sika MonoTop 611, Sika Corporation, or approved equal.

2.15 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
   2. Required average strength above specified strength:
      a. Based on a record of past performance: Determination of required average strength above specified strength shall be based on the standard deviation record of the results of at least 30 consecutive strength tests in accordance with ACI 318, Chapter 5.3 by the larger amount defined by formulas 5-1 and 5-2.
      b. Based on laboratory trial mixtures: Proportions shall be selected on the basis of laboratory trial batches prepared in accordance with ACI 318, Chapter 5.3.3.2 to produce an average strength greater than the specified strength f'c by the amount defined in table 5.3.2.2.
         1) Proportions of ingredients for concrete mixes shall be determined by an independent testing laboratory or qualified concrete supplier.
         2) For each proposed mixture, at least three compressive test cylinders shall be made and tested for strength at the specified age. Additional cylinders may be made for testing for information at earlier ages.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 20 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Slag Cement: 50 percent.
   4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Do not use admixtures which have not been incorporated and tested in accepted mixes.
   2. Use water-reducing admixture in concrete, as required, for placement and workability.
   3. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   4. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.50.

2.16 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion normal-weight concrete mixture as indicated on drawings.

2.17 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.18 FABRICATION OF EMBEDDED METAL ASSEMBLIES

A. Fabricate metal assemblies in the shop. Holes shall be made by drilling or punching. Holes shall not be made by or enlarged by burning. Welding shall be in accordance with AWS D1.1.

B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division. A minimum of two headed studs shall be tested at the start of each production period for proper quality control. The studs shall be capable of being bent 45 degrees without failure.

C. Welding of reinforcement shall be done in accordance with AWS D1.4, using the recommended preheat temperature and electrode for the type of reinforcement being welded. Bars larger than no. 9 shall not be welded. Welding shall be subject to the observance and testing of the Testing Laboratory.

D. Metal assemblies exposed to earth, weather or moisture shall be hot dip galvanized. All other metal assemblies shall be either hot dip galvanized or painted with an epoxy paint. Repair galvanizing after welding with a Cold Galvanizing compound installed in accordance with the manufacturer's instructions. Repair painted assemblies after welding with same type of paint.

2.19 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.

1. When air temperature is between 85 and 95 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 95 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

1. Vertical alignment:
   a. Lines, surfaces and arises less than 100 feet in height - 1 inch.
   b. Outside corner of exposed corner columns and control joints in concrete exposed to view less than 100 feet in height - 1/2 inch.
2. Lateral alignment:
   a. Members - 1 inch.
   b. Centerline of openings 12 inches or smaller and edge location of larger openings in slabs - 1/2 inch.
   c. Sawcuts, joints, and weakened plane embedments in slabs - 3/4 inch.
3. Level alignment:
   a. Elevation of slabs-on-grade - 3/4 inch.
   b. Elevation of top surfaces of formed slabs before removal of shores - 3/4 inch.

c. Elevation of formed surfaces before removal of shores - 3/4 inch.
d. Lintels, sills, parapets, horizontal grooves, and other lines exposed to view - 1/2 inch.

4. Cross-sectional dimensions: Overall dimensions of beams, joists, and columns and thickness of walls and slabs.
   a. 12 inch dimension or less - plus 3/8 inch to minus 1/4 inch.
   b. Greater than 12 inch to 3 foot dimension - plus 1/2 inch to minus 3/8 inch.
   c. Greater than 3 foot dimension - plus 1 inch to minus 3/4 inch.
5. Relative alignment:
   a. Stairs:
      1) Difference in height between adjacent risers - 1/8 inch.
      2) Difference in width between adjacent treads - 1/4 inch.
      3) Maximum difference in height between risers in a flight of stairs - 3/8 inch.
      4) Maximum difference in width between treads in a flight of stairs - 3/8 inch.
   b. Grooves:
      1) Specified width 2 inches or less - 1/8 inch.
      2) Specified width between 2 inches and 12 inches - 1/4 inch.
   c. Vertical alignment of outside corner of exposed corner columns and control joint grooves in concrete exposed to view - 1/4 inch in 10 feet.
   d. All other conditions - 3/8 inch in 10 feet.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   1. Class A, 1/8 inch for smooth-formed finished surfaces.
   2. Class D, 1 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide elevation or camber in formwork as required for anticipated formwork deflections due to weight and pressures of concrete and construction loads.

H. Foundation Elements: The sides of all below grade portions of beams, pier caps, walls, and columns shall be formed straight and to the lines and grades specified. Foundation elements shall not be earth formed unless specifically indicated on the Drawings.

I. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

J. Chamfer exterior corners and edges of permanently exposed concrete.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

N. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.

1. Do not apply form release agent where concrete surfaces are scheduled to receive subsequent finishes which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   a. Spacing within a bolt group: 1/8"
   b. Location of bolt group (center): 1/2"
   c. Rotation of bolt group: 5 degrees
   d. Angle off vertical: 5 degrees
   e. Bolt projection: ± 3/8"
2. Headed Studs: Heads welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division.
3. Welded Deformed Bar Anchors: ASTM A1064/ A1064M: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.

3.3 VOID FORMS

A. Install void forms in all locations shown on the Drawings. In general, void forms shall be placed below all structural elements supported by piers to separate these elements from the earth.

B. Seal discontinuous ends of void forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between void form sections.

C. Premanufactured void forms with circular edges shall be used around all drilled piers. Field fabrication of pier void forms is not permitted.

D. Do not allow any portion of void forms to fall within the circumference of piers causing a reduction in the bearing area.

E. Protect void forms from water. Do not install void forms during wet weather or on wet ground. Void forms which become saturated prior to placement of concrete shall be removed and replaced. Void forms shall not be wrapped in plastic, or other similar material to protect from moisture when installed.

F. Exercise care in placement of concrete to avoid collapse of void form. If void forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created by installing soil retainers on each side of element.

G. Void forms under slabs shall be protected by a layer of one-eighth inch thick protection board followed by a vapor barrier or retarder per the specifications. Do not install void forms under soil supported slabs on grade.

3.4 SOIL RETAINERS

A. Install soil retainers in straight, clean trenches at sides of void forms prior to concrete placement. The gaps between the trench and retainers must be properly positioned or backfilled prior to the placement of concrete. Do not cast the sides of concrete beams directly against the soil.

B. Affix the soil retainers to the concrete beam with adhesive, pin/washer/load, or concrete hard nails spaced on 24 inch centers.

3.5 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems which allow form removal without disturbing shores, but only after the Contractor has demonstrated to the satisfaction of the Architect that the early removal of forms will not cause excessive sag, distortion or damage to the concrete elements.
3. Wood forms shall be completely removed. Provide temporary openings if required.
4. Provide adequate methods of curing and thermal protection of exposed concrete if forms are removed prior to completion of specified curing time.
5. Areas required to support construction loads in excess of 20 psf shall be reshored to properly distribute construction loading. Construction loads up to the rated live load capacity may be placed on unshored construction provided the concrete has attained the specified 28 day compressive strength.
6. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
7. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

B. Lap joints 6 inches and seal with tape as noted below.

1. Vapor retarder membrane seal at slabs on void forms for use with membranes that are not self-adhering to the underside of concrete slabs: Seal vapor retarder membrane to underside of slab using perimeter/seam seal tape applied continuously to perimeter of vapor retarder membrane at grade beams (3in. tape) and at the seams at interior conditions (6in. tape).
   a. Apply double-sided adhesive tape top surface of grade beam and adhere membrane to tape. Refer to the drawings for detail.
   b. Remove any dirt or debris from membrane prior to application of sealing tape.
2. General sealing and at slabs on grade: Use manufacturer’s standard adhesive or pressure sensitive tape for sealing membrane at seams, pipe penetrations, tears, etc.

3.7 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated. Only steel conforming to ASTM A706 may be welded.

D. Installation tolerances:

1. Top and bottom bars in slabs, girders, beams and joists:
   a. Members 8" deep or less: ±3/8"
   b. Members more than 8" deep: ±1/2"
2. Concrete Cover to Formed or Finished Surfaces: ±3/8" for members 8" deep or less; ±1/2" for members over 8" deep, except that tolerance for cover shall not exceed 1/3 of the specified cover.

E. Concrete Cover: Refer to the Structural Notes.

F. Splices: Provide standard reinforcement splices by lapping and tying ends. Comply with ACI 318 for minimum lap of spliced bars where not specified on the documents.

G. Mechanical Splices: Use for splicing of bars larger than no. 11 or where no. 11 bars are spliced to larger size bars and where indicated on the drawings. Comply with manufacturer's instructions for preparation of bars and installation procedures.

H. Field Welding of Embedded Metal Assemblies: All paint and galvanizing shall be removed in areas to receive field welds. All areas where paint or galvanizing has been removed shall be field repaired with the specified paint or cold galvanizing compound, respectively.

I. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

J. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.8 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.9 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.10 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, and only if specifically noted as withheld on the batch ticket.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
   2. Water content shall not exceed the maximum specified water/cement ratio for the mix.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
   4. Do not permit concrete to drop freely any distance greater than 20'-0" for concrete containing a high range water reducing admixture (superplasticizer) or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
   5. Pump priming grout shall be discarded and not used in the structure.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 305.1 and as follows:
   1. Maintain concrete temperature below 95 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.11 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

1. Housekeeping pads: Concrete fill shall be normal weight concrete (3000 psi), reinforced with 4x4-W2.1xW2.1 welded wire mesh set at middepth of pad. Trowel concrete to a dense, smooth finish. Set anchor bolts for securing mechanical or electrical equipment during pouring of concrete fill.

D. Protective slabs ("Mud slabs"): Concrete fill shall be normal weight concrete (2500 psi minimum) with a minimum thickness of 3 1/2". Reinforce protective slabs with 6x6-W2.9xW2.9 welded wire mesh reinforcing. Finish slab to a wood float finish.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 CONCRETE SURFACE REPAIRS

A. Surface Defects in Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Owner's approval.

B. Contractor shall submit a detailed, descriptive procedure listing proposed pre-packaged repair materials and methods for the repair of surface defects prior to the start of repair work.

C. Patching Mortar: Mix, place and finish pre-packaged repair mortar in accordance with manufacturer’s instructions.

D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, minor honeycombs and rock pockets with no exposed reinforcement, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out minor honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface, 1/4 inch deep minimum. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view using pre-packaged repair mortar so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

E. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
   1. Repair finished surfaces containing defects. Surface defects include minor spalls, pop outs, honeycombs and rock pockets with no exposed reinforcement, crazing and cracks in excess

of 0.01 inch wide that do not penetrate to reinforcement, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with patching mortar. Remove defective areas with clean, square cuts, ¼" deep minimum. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Place, compact, and finish patching mortar to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
8. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

3.15 STRUCTURAL REPAIRS

A. Structurally Defective Concrete: Structural defects include spalls, honeycombs or rock pockets with exposed reinforcement, hollow-sounding concrete, cracks that penetrate to the reinforcement or completely through concrete elements, inadequate cover over reinforcement, and other conditions that affect the structural performance or durability of the concrete as determined by the Engineer.

B. Repair structural defects in concrete in accordance with plans, specifications, details, etc. provided by the Engineer.
   1. The cost of the additional services provided by the Engineer to prepare the repair documents, and to oversee the repair work shall be borne by the Contractor.

C. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

3.16 CLEANUP

A. Imperfect or damaged work or any material damaged or determined to be defective before final completion and acceptance of the entire job shall be satisfactorily replaced at the Contractor's

expense, and in conformity with all of the requirements of the Drawings and Specifications. Removal and replacement of concrete work shall be done in such manner as not to impair the appearance or strength of the structure in any way.

B. Cleaning: Upon completion of the work all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the site. After sweeping floors, wash floors with clean water. Finished concrete surfaces shall be left in a clean condition, satisfactory to the Owner.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner may engage a special inspector and/or a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections may include:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.
   3. Headed bolts and studs.
   4. Verification of use of required design mixture.
   5. Concrete placement, including conveying and depositing.
   6. Curing procedures and maintenance of curing temperature.
   7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; 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 C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
   5. Compressive-Strength Tests: ASTM C 39/C 39M;
      a. Test one cylinder at 7 days
      b. Test two cylinders at 28 days
      c. Test one cylinder at 56 days
      d. If 4” by 8” cylinders are used, provide 1 additional cylinder at each stage
   6. 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.

7. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
    a. When the strength level of the concrete for any portion of the structure, as indicated by cylinder tests, falls below the specified requirements, the Contractor shall provide improved curing conditions and/or adjustments to the mix design as required to obtain the required strength. If the average strength of the laboratory control cylinders falls so low as to be deemed unacceptable, the Contractor shall follow the core test procedure set forth in ACI 301, Section 1.6. Locations of core tests shall be approved by the Architect. Core sampling and testing shall be at Contractors expense.
    b. If the results of the core tests indicate that the strength of the structure is inadequate, any replacement, load testing, or strengthening as may be ordered by the Architect shall be provided by the Contractor without cost to the Owner.
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 does not comply with the Contract Documents.

END OF SECTION

SECTION 03 30 00.01

CIVIL CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SCOPE

A. This section gives requirements for normal weight structural concrete.

B. Coordinate the requirements of this section with all other sections of Division 3, Concrete. All requirements of this section apply to those except as may be otherwise specified in such sections.

1.2 REFERENCE STANDARD

The current issue of ACI-318, "Specifications for Structural Concrete for Buildings" is a part of this specification and is applicable to this project.

1.3 SUBMITTALS

A. Mill Certificates. Required for all bulk cement and reinforcing steel.

B. Admixtures. Submit brochures on admixtures proposed for use if different from those specified.

1. A submittal is required from the manufacturer of the approved air-entraining admixture. Give requirements to control percent of air content under all conditions including temperature variations. Provide three (3) copies.
2. A submittal is required from the manufacturer of the approved water-reducing retarder. Give requirements for quantities and types to be used under various temperatures and job conditions to produce a uniform, workable concrete mix.

C. Design Mixes. Submit test data on proposed design mixes for each type of concrete in the project.

D. Curing Method. Submit the proposed curing method for all concrete. If the use of a white pigmented membrane-forming compound is recommended, submit evidence that the compound is satisfactory for the intended application. A written guarantee will be required.

1.4 STORAGE OF MATERIALS

A. Cement. Store cement in weather tight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.

B. Aggregate. Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding three-feet (3') in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregates.

C. Sand. Before using, allow sand to drain until uniform moisture content is reached.

D. Admixtures. Store admixtures to avoid contamination, evaporation or damage. For those used in the form of suspensions or nonsoluable solutions, provide suitable agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and other temperature changes which would adversely affect their characteristics.

1.5 TESTING LABORATORY SERVICES

The tests required in this section will be performed by a commercial testing laboratory as specified in Division 1, General Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement. Use cement conforming to ASTM C-150, Type "I." Type III may be used when specifically authorized. Use the same brand of cement upon which the selection of concrete was based. Only one (1) brand of each type will be permitted in any one structure, unless otherwise specified.

B. Admixtures. Use the following admixtures as required or permitted. The use of calcium chloride will not be permitted. The products must conform to the referenced standards.
   1. Air-entraining Admixtures. Conform to ASTM C-260, such as Sika's "AER," Sonneborn's "Aerolith" or approved equal.
   2. Chemical Admixtures. Conform to ASTM C-494, "Tentative Specifications for Chemical Admixtures for Concrete."
   3. Water-reducing Retarder. Use of an admixture containing chloride is not permitted. The product must be nonstaining. Use Master Builder's "MBHC," Sika's "Plastiment" or approved equal.

C. Mixing Water. Fresh, clean and drinkable.

D. Aggregates. Use coarse aggregate from only one (1) source and fine aggregate from only one (1) source for exposed concrete in a single structure.
   1. Coarse aggregate for normal weight concrete shall conform to ASTM C-33. Grading limits for precast, prestressed members and for all members six- inches (6") or less in least dimension, one-inch (1") to No. 4. Grading for all other normal weight concrete, 1½-inches (1½") to No. 4.
   2. Use natural sand complying with ASTM C-33 for fine aggregate in normal weight concrete.

E. Membrane-forming Curing Compound. ASTM C-309, white pigmented commercial curing compound which will not permanently discolor concrete.

F. Sheet Material for Curing Concrete. ASTM C-171, waterproof paper, polyethylene film or white burlap-polyethylene sheeting.

G. Non-shrink Grout. Unless otherwise specified, use Master Builders' "Embeco 153," or approved equal, consisting of specially prepared catalyzed metallic aggregate, Portland cement that is not air-entrained, and specially size-graded sand.

H. Reinforcing Steel. Use ASTM A-615, Grade 60 reinforcing steel, unless otherwise specified or noted on the drawings. Use deformed bars except where smooth bars are specified.

I. Expansion Joints. Use ASTM D-994 expansion joint filler, ¾-inches (¾") thick, unless otherwise show, from full depth to one-inch (1") above the slab. Use ASTM-1190 joint sealer to fill the joint. Provide joint filler and sealer at locations shown.

2.2 PROPORTIONING

A. Objective. Select proportion of ingredients to produce concrete having proper placability, durability, strength, appearance, and other required properties. Proportion ingredients to produce a homogeneous mixture which will work readily into corners and angles of forms and around reinforcement by methods of placing and consolidation employed on the work, but without permitting materials to segregate or allowing excessive free water to collect on the surface.

B. Strength. Provide ultimate strength concrete in all portions of the work. Strength must conform to values for the class of concrete specified for each portion of the structure. Requirements are based on 28-day compressive strength. If high early-strength concrete is specified, requirements are based on seven (7) day compressive strength.

C. Entrained Air. Air-entrain all concrete, unless otherwise specified. Provide for not less than three-percent (3%) nor more than five-percent (5%) by volume of total entrapped and entrained air for normal weight concrete.

D. Slump. The maximum permissible slump for concrete is five-inches (5"); the minimum is three-inches (3"). Determine slump by methods given in ASTM C-143.

E. Admixtures. Proportion admixtures according to the manufacturer's recommendations. Use of an approved accelerator is permitted when the air temperature is less than 40□ F. Use of an approved retarder is required when the temperature of placed concrete exceeds 85□

F. Classification and Use.

1. Classification:

Class	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Contents Sacks per Cubic Yard*
Normal Weight		
A	3000	5
Sidewalks		
B	2500	4½
Structural		
C	4000	6

* If the required strength is not secured with the minimum cement content as specified, add cement or provide other aggregates as necessary.

G. Water-Cement Ratio for Normal Weight Concrete. If the relationship between strength and the water-cement ratio has been determined previously for materials specified for normal weight concrete, the ratio may be used. Otherwise, determine the proper water-cement ratio by using the following procedures.
   1. Make concrete trial mixtures having suitable proportions and consistency. Use at least three (3) different water-cement ratios which will produce a range of strengths encompassing those required. Design trial mixes to produce the maximum allowable slump.
   2. Determine proportions of ingredients and conduct tests in accordance with basic relationships and procedures outlined in ACI 613, "Recommended Practice for Selecting Proportions for Concrete."
   3. Make and cure specimens according to ASTM C-192, "Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory." For each water-cement ratio, prepare at least three (3) specimens for each age test. Test for strength at seven (7) days and 28 days, or other age as required. Conduct tests according to ASTM C-39, "Method of Test for Compressive Strength of Molded Concrete Cylinders."
   4. From results of these tests plot a curve showing the relationship between water-cement ratio and compressive strength.

H. Alternate Determination of Proportions. In lieu of proportioning as specified for normal and lightweight concrete, a mix design employing the same ingredients proposed for use, and used successfully on previous projects under similar conditions may be used. To obtain the necessary approval, submit the following:
   1. Concrete mix design.
   2. Reports for at least 20 consecutive sets of 7-day and 28-day concrete strength tests made during the last six (6) months.
   3. Reports of compliance tests of fine and coarse aggregates made during last six (6) months.

2.3 MIXING NORMAL WEIGHT CONCRETE

A. Ready-Mixed Concrete. Mix and transport ready-mixed concrete according to ASTM C-94, "Specifications for Ready-Mixed Concrete." In addition, the batch plant shall provide for the following items:
   1. Arrangement. Provide separate bins or compartments for different sized aggregates and for bulk cement. Compartments of ample size constructed so that materials will be kept separate under all working conditions are required.
   2. Weighing of Materials. Aggregates may be weighed in separate weigh batchers with individual scales. Weigh bulk cement on a separate scale in a separate weigh batcher. Observe the following limits of accuracy when weighing or measuring materials.

Materials	Percent Accuracy
Cement	1
Water	1
Aggregates	2
Admixture	3

3. Water Meter or Batcher. Provide a suitable measuring device capable of measuring mixing water within the specified accuracy for each batch. Note the number of gallons of water as batched on printed batching tickets.
4. Moisture Control. Provide a moisture meter to measure the amount of free water in fine aggregates within 0.3 of a percent. Compensate for varying moisture contents of fine aggregates and change batch weights of materials if necessary before batching.
5. Scales. Provide adequate facilities for accurate measurement and control of each material entering each batch of concrete. Accuracy of weighing equipment must conform to applicable requirements of ASTM and NRMCA for such equipment.
6. Recorders or Printers. Provide recorders/printers to produce tickets. Each ticket will provide a printed record of weights for cement as batched and for separate aggregates as batched individually. Use the type of indicator that returns for zero punch or to zero after a batch is discharged. Clearly indicate by stamped letters or numbers the difference between aggregates and cement as batched. Show the time of day stamped or printed at intervals of not more than six (6) minutes. Deliver recorded ticket copies with concrete. The testing agency will keep one (1) copy.
7. Protection. Protect weighing, indicating, recording or printing, and control equipment against exposure to dust and weather.

B. Transit Mix Truck Requirements.
1. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant.
2. Keep the water tank valve on each transit truck locked at all times that the truck is in use. Any addition of water must be directed by the Engineer. Added water must be incorporated by additional mixing of at least 35 revolutions or two (2) minutes.
3. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

C. Batch Mixing at Site.
1. Mix concrete in a batch mixer conforming to requirements of the Mixer Manufacturers' Bureau of the Associated General Contractors of America. Use a mixer equipped with a suitable charging hopper, water storage tank and water measuring devices. It must be capable of thoroughly mixing aggregates, cement and water into a uniform mass within the specified mixing time, and of discharging the mix without segregation. Operate the mixer according to the rated capacity and recommended revolutions per minute printed on the manufacturer's rating plate.
2. Charge the batch into the mixer so that some water will enter in advance of cement and aggregates. Keep water running until ¼ of specified mixing time has elapsed. Provide controls to prevent discharging until the required mixing time has elapsed. When concrete of normal weight is specified, provide controls to prevent the addition of water during mixing. Discharge the entire batch before the mixer is recharged.
3. Mix each batch of two (2) cubic yards or less for not less than one (1) minute and 30 seconds. Increase mixing time 15 seconds for each additional cubic yard or fraction of a yard.
4. Keep the mixer clean. Replace pick-up and throw-over blades in the drum when they have lost 10 percent (10%) of original depth.

D. Admixtures.

1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device. Measure admixture to an accuracy within ±3 percent (3%). Do not use admixtures in powdered form.
2. Two (2) or more admixtures may be used in the same concrete, provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other. Inject the admixtures separately during the batching sequence.
3. Add retarding admixtures as soon as practicable after the addition of cement.

E. Temperature Control.
1. When the mean temperature falls below 40º F, keep the admixed temperature above 55º F to maintain concrete above the minimum placing temperature.
2. If water or aggregates have been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to the mixtures of water and aggregate when the temperature of the mixture is greater than 95º F.
3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature. If necessary, substitute well-crushed ice for all or part of the mixing water.

PART 3 - EXECUTION

3.1 JOINT PREPARATION

Thoroughly roughen the top surface of concrete placement terminating at the construction joints as soon as practical after initial set is attained.

Clean hardened concrete surfaces of all loose material, laitance, dirt, and foreign matter, and saturate it with water. Pressure washing is not acceptable. Remove all free water and moisten the surface before concrete or bonding grout is placed against it.

Coat the joint surface with bonding mortar, grout, epoxy or other material as indicated in the plans. Provide Type V epoxy for bonding fresh concrete to hardened concrete:

A. Eucopoxy LPL MV
B. Sikadur Hi-Mod
C. Or approved equal.

Place bonding agents in accordance with the manufacturer's recommendations.

3.2 CONCRETE PREPARATION

A. Coordination. Mix concrete only in quantities for immediate use. Discard concrete which has set. Retempering of set concrete is not permitted. Completely discharge concrete at the site within one (1) hour and 30 minutes after adding cement to aggregate. In hot weather reduce this time to one (1) hour or less to prevent stiffening of concrete before it is placed.

B. Protection from Adverse Weather. Unless adequate protection is provided or approval is obtained, do not place concrete during rain, sleet, snow or freezing weather. Do not permit rainwater to increase mixing water or to damage the surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect the work.

C. Placing Temperature.
1. Cold Weather. Unless special provisions are made for heating the concrete mix and concrete in forms, do not place any concrete when the air temperature is below 40º F or is predicted to be below 40º F within the next 48 hours after placement. Provide and use protective material and heating equipment as required to maintain the temperature of the concrete surface at not less than 35º F for a period of at least 36 hours after placement.
2. Hot Weather. When the air temperature is above 85º F, use of an approved retarding agent is required in all concrete. Concrete temperature prior to placement shall not exceed 95º F.

D. Adjusting Slump. If concrete arrives at the project with slump below that specified, water may be added. Indiscriminate addition of water to increase slump is prohibited. Do not exceed either the maximum permissible water-cement ratio or maximum slump. Any addition of water above the maximum water-cement ratio must be accompanied by a corresponding quantity of cement. Mix adjustments to obtain specified slump must be approved and directed by the Engineer.

3.3 CONVEYING

A. Objectives. Handle concrete from mixer to placement as quickly as practicable while providing concrete to required quality in the placement area. Use methods which prevent loss of ingredients and segregation.

B. Equipment. Obtain approval of the conveying equipment. Select equipment of size and design to insure continuous flow of concrete at the delivery end. Conform to the following equipment and operations requirements.

1. Provide truck mixers, agitators, nonagitating units and manner of operation conforming to requirements of ASTM C-94, "Specifications for Ready-Mixed Concrete."
2. Use belt conveyors configured horizontally or at a slope which causes no segregation or loss. Use an approved arrangement at the discharge end to prevent separation. Discharge long runs without separation into a hopper.
3. Provide metal or metal-lined chutes. Arrange for slopes not exceeding one (1) vertical to two (2) horizontal and not less than one (1) vertical to three (3) horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
4. Pumping of concrete will be permitted only after written approval. Use a batch design and aggregate sizes suitable for pumping.

C. Maximum Time to Placement

The maximum time interval between the addition of cement to the batch, and the placing of concrete in the forms shall not exceed the following:

Air or Concrete Temperature (Whichever is Higher)	Maximum Time (Addition of Water or Cement to Placing in Forms)
Non-Agitated Concrete	
Over 80°F	15 Minutes
35°F to 79°F	30 Minutes
Agitated Concrete	
90°F or Above	45 Minutes
75°F to 89°F	60 minutes
35°F to 74°F	90 Minutes

The use of an approved retarding agent in the concrete will permit the extension of each of the above temperature-time maximums by 30 minutes for bridge decks, top slabs of direct traffic culverts and cased drilled shafts, and one hour for all other concrete except that the maximum time shall not exceed 30 minutes for non-agitated concrete.

3.4 PLACING

A. Preparation. In addition to the previous requirements, confirm that formwork has been completed. Remove ice, excess water, dirt and other foreign materials from forms. Confirm that reinforcement is securely in place and expansion joint material, anchors and other embedded items are properly positioned. Have a competent workman at the pour location who can assure that reinforcement and embedded items remain in design locations while concrete is being placed. Sprinkle semi porous subgrades to eliminate suction. Seal extremely porous subgrades in an approved manner.

B. Procedure.
   1. Deposit concrete continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
   2. Proceed with placement at a rate such that concrete which is being integrated with fresh concrete is still plastic. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
   3. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only if made of galvanized metal or concrete, and if prior approval has been obtained.
   4. Do not start placing of concrete in supported elements until concrete previously placed in columns and walls is no longer plastic.
   5. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to a procedure which will cause segregation.
   6. Where surface mortar is to be the basis of a finish, especially those designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of mortar against the form. Prevent formation of excessive surface voids.
   7. Consolidate concrete by vibration, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, around embedded items and into corners of forms. Eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness. A minimum frequency of 7000 revolutions per minute is required for mechanical vibrators. Do not use vibrators to transport concrete within forms. Insert vibrators and withdraw at points from 18 to 30 inches apart. At each insertion vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over-vibrate causing segregation. Keep a spare vibrator on the site during concrete placing operations.

C. Concreting Under Water. When required or permitted, deposit concrete under water by an approved method. Obtain advanced approval of the method from the Engineer. Deposit concrete in such a way that fresh concrete enters the mass of previously placed concrete from within, causing water to be displaced with a minimum disturbance at the surface of the concrete.

3.5 REPAIRING SURFACE DEFECTS

A. Defective Areas. Repair defective areas immediately after the removal of forms.
   1. Remove honeycombed and other defective concrete down to sound concrete. To prevent absorption of water from patching mortar, dampen the defective area and a strip six-inches (6") wide surrounding the area to be patched. Prepare bonding grout by mixing approximately one (1) part cement to one (1) part fine sand passing a No. 30 mesh sieve. Mix to a consistency of thick cream, and brush thoroughly into the surface.
   2. Make patching mortar of the same materials and of approximately the same proportions as concrete, except omit coarse aggregate. Prepare mortar with not more than one (1) part cement to 2½ parts sand by damp loose volume. Substitute white Portland cement for part of the gray Portland cement on exposed concrete in order to produce a color matching the color of surrounding concrete. Determine color by making a trial patch.
   3. Use no more mixing water than necessary for handling and placing. Mix patching mortar in advance and allow to stand. Mix frequently with a trowel until it has reached the stiffest consistency that will permit placing. Do not add water.
   4. After surface water has evaporated from the area to be patched, thoroughly brush a coat of bond grout into surface. When bond grout begins to lose its water sheen, apply the

premixed patching mortar. Thoroughly consolidate the mortar into place and strike off to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave undisturbed for at least one (1) hour before final finishing. Keep the patched area damp for seven (7) days. Do not use metal tools in finishing patches in a formed wall which will be exposed.

B. Tie Holes. Patch tie holes immediately after removal of forms. After cleaning and thoroughly dampening the tie hole, fill solid with patching mortar.

C. Proprietary Materials. If permitted or required, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Use such compounds according to the manufacturer's recommendations.

3.6 FINISHING OF FORMED SURFACES

A. Surfaces Requiring No Finish. A finish is not required on surfaces concealed from view by earth, water, ceiling, etc. in the completed structure.

B. Smooth Form Finish.

1. Use plywood or fiberboard linings or forms in as large sheets as practicable and with smooth, even edges and close joints.
2. Patch tie holes and defects. Rub fins and joint marks with carborundum blocks to leave a smooth, unmarred finished surface.
3. Rubbed Finishes. In basins that contain liquids with normal water levels, the rubbed finish need only extend 3 feet below the normal level. Where fill dirt is placed against an exterior surface, extend the finish 3 feet below the finished grade. All other visible surfaces shall receive a finish. Produce one of the following finishes on concrete specified to have a smooth form finish:
   a. Smooth-rubbed finish – Produce finish on newly hardened concrete no later than the day following formwork removal. Wet the surface and rub it with carborundum brick or other abrasive until uniform color and texture are produced. Use no cement grout other than cement paste drawn from the concrete itself by the rubbing process.
   b. Grout-cleaned finish – Begin cleaning operations after contiguous surfaces to be cleaned are completed and accessible. Do not clean surfaces as work progresses. Wet the surface and apply grout consisting of one part portland cement and one and one-half parts fine sand with enough water to produce the consistency of thick paint. Add white cement as needed to match color of surrounding concrete. Scrub grout into voids and remove excess grout. When grout whitens, rub the surface and keep the surface damp for 36 hours afterward.
   c. Cork-floated finish – Wet the surface and apply stiff grout of one part portland cement and one part fine sand, filling voids. Add white cement as needed to match color of surrounding concrete. Use enough water to produce a stiff consistency. Compress grout into voids by grinding the surface with a slow-speed grinder. Produce the final finish with cork float, using a swirling motion.

3.7 FINISHING SLABS AND SIMILAR FLAT SURFACES

A. Shaping to Contour. Use strike-off templates or approved compacting-type screeds riding on screed strips and edge forms to bring concrete surface to the proper contour. See the section on Concrete Formwork for edge forms and screeds.

B. Consolidation. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Obtain consolidation of slabs and floors with vibrating bridge screeds, roller pipe screeds, or other approved means. Concrete to be consolidated must be as dry as practicable. Do not permit manipulation of surfaces prior to finishing operations.

C. Tolerances for Finished Surfaces. Tolerances are checked by placing a straightedge of specified length anywhere on the slab. The gap between slab and straightedge must not exceed the tolerance listed for the specified class.

Class	Straightedge Length In Feet	Tolerance In Inches
A	10	
B	10	¼
C	10	⅛

D. Floated Finish.
1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when the mix has stiffened sufficiently to permit proper operation of a power-driven float. Consolidate the surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to a power-driven machine and on small, isolated slabs.
2. Recheck tolerance of the surface after initial floating with a 10-foot (10') straightedge applied at not less than two (2) different angles. Cut down high spots and fill low spots to Class "B" tolerance. Immediately refloat slab to uniform, smooth, granular texture.

E. Troweled Finish.
1. To obtain a troweled finish, a floated finish as previously specified must be applied. After power floating, use a power trowel to produce a smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional trowelings by hand after the surface has hardened sufficiently. Do final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate the surface by hand troweling operations.
2. Produce a finished surface free of trowel marks, uniform in texture and appearance and conforming to Class "A" tolerance. On surfaces intended to support floor coverings, remove defects which might show through covering by grinding.

3.8 CURING PROCEDURES

A. Objective. Protect freshly deposited concrete from premature drying and excessively hot or cold temperatures. Maintain a minimal moisture loss and a relatively constant temperature during the time necessary for hydration of cement and proper hardening of concrete.

B. Initial Curing. Immediately after the finishing operation, begin initial curing. Keep concrete continuously moist at least overnight. Use one of the following materials and methods for initial curing:
1. Ponding or continuous sprinkling.
2. Absorptive mat or fabric kept continuously wet.
3. Sand or other covering kept continuously wet.
4. Continuous steam bath (not exceeding 150º F at the surface of concrete).
5. Vapor mist bath.
6. Membrane-forming curing compound applied according to the manufacturer's recommendations.

C. Final Curing. Immediately following the initial curing and before concrete has dried, provide additional curing by one (1) of following materials or methods:
1. Continuing the method used in initial curing.
2. Waterproof paper, polyethylene film or white burlap-polyethylene sheeting.
3. Other moisture-retaining coverings as approved.

D. Duration of Curing. Continue final curing until the cumulative number of days or fractions of days during which the ambient temperature is above 50º F has totaled seven (7). If high-early-

strength concrete has been used, combine final curing for a total of three (3) days. Prevent rapid drying at the end of the curing period.

E. Curing Day. A curing day is defined as a calendar day when the temperature, taken in the shade away from artificial heat, is above 50º F for at least 19 hours, (or colder days if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 40º F for the entire 24 hours). The required curing period shall begin when all concrete has attained its initial set.

F. Formed Surfaces. Steel forms heated by the sun and wood forms in contact with concrete during final curing period shall be kept wet. If forms are to be removed during the curing period, employ one (1) of the above curing materials or methods immediately. Continue such curing for the remainder of the curing period.

G. Temperature.
   1. Cold Weather. Place concrete only when the temperature is above 40º F and rising. Place no concrete if the temperature is below 50º F and falling. Maintain the ambient temperature of the air surrounding the concrete above 50º F for the required curing period. When necessary, make arrangements for heating, covering, insulating or housing concrete work in advance of placement to maintain the required temperature and moisture conditions. Prevent injury due to concentration of heat.
   2. Hot Weather. When necessary, make arrangements for installation of windbreaks, shading, fog spraying, sprinkling, ponding or wet covering of light color in advance of placement. Take such protective measures, as quickly as concrete hardening and finishing operations will allow.
   3. Temperature Changes. Control changes in temperature of concrete at a rate as uniform as possible. Do not permit a temperature change to exceed 5º F in any one hour or 50º F in any 24-hour period.

H. Protection From Mechanical Injury. During the curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock and excessive vibration. Protect finished concrete surfaces from damage caused by construction equipment, materials, or methods and by rain or running water. Do not load self-supporting structures in any way that overstresses concrete.

I. Membrane Curing Requirements.
   1. After concrete has received final finish and surplus water sheen has disappeared, seal surface with a single uniform coating of approved curing compound applied at rate of coverage recommended by manufacturer and as directed by Engineer, but not less than one (1) gallon per 180 square feet of area. Provide satisfactory means and facilities to properly control and check rate of application of compound.
   2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers, equipped with satisfactory atomizing nozzles, except that for application on small miscellaneous items, hand powered spray equipment may be used. For all spraying equipment, prevent loss of compound between nozzle and concrete surface during spraying operations.
   3. Do not apply compound to a dry surface. If surface of concrete has become dry, thoroughly moisten immediately previous to application. At locations where coating shows discontinuities, pin holes or other defects, or if rain falls on newly coated surface before film has dried sufficiently to resist damage, apply an additional coat of compound immediately, at same rate of coverage specified herein.
   4. Use any of the following curing compounds for unformed surfaces:
      a. ShepCure City White
      b. W.R. Meadows 1600 White Series
      c. Day-Chem White Pigmented Cure (J-8)
      d. Or approved equal.

5. Use any of the following curing compounds for all formed surfaces to receive further surface treatment or additional concrete:
   a. Shep Cure 309 Rez All
   b. W.R. Meadows 1100 – Clear Resin Based
   c. Day – Chern Rez Cure (J-11-W)
   d. Or approved equal.

END OF SECTION

SECTION 03 35 00
CONCRETE FLOOR FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Finishing slabs-on-grade, monolithic floor slabs, and separate floor toppings.

B. Related Sections include the following:
   1. Division 3 Section "Cast-in-Place Concrete" for concrete slab construction and finish.

1.3 REFERENCES

A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
   1. ACI 301 - Specifications for Structural Concrete for Buildings
   2. ACI 302 - Guide for Concrete Floor and Slab Construction
   3. ASTM E1155 - Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
   1. The Contractor shall call a meeting to review the detailed requirements for floor construction, including the concrete placing techniques, finishing techniques, curing techniques, and the application of floor finishing materials. All contractors involved in the floor installation shall attend the conference.
   2. The Contractor shall notify the Owner, Architect and the Structural Engineer at least 10 business days prior to the scheduled date of the conference.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage, mixing with other components, and application.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

PART 2 - PRODUCTS

2.1 RELATED MATERIALS

A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of 80 per ASTM D 2240.
B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
C. Sawcut joint filler: Euco 700 epoxy by The Euclid Chemical Company, or approved equal.

PART 3 - EXECUTION

3.1 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
B. Concrete slabs shall be finished as specified below, within the tolerances specified elsewhere in this Section.
    1. Highway straightedges are recommended for use in lieu of bullfloats for all slab placement and finishing operations.
    2. Screeding: Immediately after placing, slab shall be vibrated and struck off true by double screeding to the required level, at or below the elevation or grade of the finished slabs as indicated on the Drawings. Vibrators shall not be used to spread the concrete. When camber is indicated for slabs supported on formwork, screed to the required camber. Fixed screed guides are recommended where specified surface tolerance exceeds FF25/FL20.
    3. Floating: Immediately after screeding, before any excess bleed water is present on the surface, float the surface using long-handled bull floats or darbies.
    4. Straightedging: Immediately after screeding and before excess bleed water is present on the surface, straighten the surface using a highway straightedge.
    5. Edging and jointing, where required, shall be done after bleed water has evaporated and before further finishing.
    6. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
    7. Apply float finish to surfaces to receive trowel finish .
    8. Locations: All concrete surfaces under waterproofing membrane, setting beds for brick, mud-set tile, pavers, or terrazzo, and noncomposite topping slabs.
C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
    1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

2. Locations: Exposed concrete floors not otherwise specified, concrete surfaces under carpets, vinyl tile, thin set tile, wood flooring, elastomeric coatings, and painted concrete floors, and roof slabs that are future floors.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.2 CONTROL JOINTS

A. Saw-cut Control Joints: Form weakened-plane control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete floor topping when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.

B. Saw-cut Control Joints with Soff-Cut saw: After completion of finishing operation, cut control joints using a "Soff-Cut" brand electric saw along straight lines where called for on the Drawings. Follow manufacturer's instructions in using "Soff-Cut" saw. Sawcutting shall be done within 2 hours after the completion of finishing, but not so soon as to cause raveling of the joint. Cut to depth indicated on the Drawings.
   1. After completion of finishing operations, cut control joints along straight lines where called for on the Drawings. Saw cutting shall be done within 4 hours after the completion of finishing, but not so soon to cause raveling of the joint. Cut to the depth indicated on the Drawings.

C. Form joints in concrete floor topping over control joints in base slabs, unless otherwise indicated.

D. Construct control joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness.

E. Construct control joints for a depth equal to one-half of concrete floor topping thickness, but not less than 1/2 inch deep.

3.3 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.
   1. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.4 CONCRETE FINISH MEASUREMENT AND TOLERANCES

A. All floors are subject to measurement for flatness and levelness and shall comply with the following:
   1. Measurement Standard: All floors are subject to measurement for flatness and levelness, according to ASTM E1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System."

B. Two Tiered Measurement Standard: Each floor test section and the overall floor area shall conform to the two-tiered measurement standard as specified herein.
   1. Minimum Local Value: The minimum local FF/FL values represent the absolute minimum surface profile that will be acceptable for any one test sample (line of measurements) anywhere within the test area.
   2. Specified Overall Value: The specified overall FF/FL values represent the minimum values acceptable for individual floor sections as well as the floor as a whole.

C. Floor Test Sections
   1. A floor test section is defined as the smaller of the following areas:
      a. The area bounded by column and/or wall lines.
      b. The area bounded by construction and/or control joint lines.
      c. Any combination of column lines and/or control joint lines.
   2. Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines, as defined by ASTM E1155, at a spacing to be determined by the Owner's testing agency.
   3. The precise layout of each test section shall be determined by the Owner's testing agency.

D. Concrete Floor Finish Tolerance
   1. The following values apply before removal of shores. Levelness values (FL) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
      a. Slabs on Ground:
         1) Floors to be covered with carpet or vinyl tile, unless otherwise specified:
            a) Overall Value FF25/FL20
            b) Minimum Local Value FF17/FL15
         2) Parking Floors:
            a) Overall Value FF20/FL15
            b) Minimum Local Value FF15/FL10
         3) Floors to be covered with thin-set tile:
            a) Overall Value FF35/FL25
            b) Minimum Local Value FF24/FL17
         4) Mechanical rooms, thickset tile, recessed floors and roof slabs:
            a) Overall Value FF20/FL15
            b) Minimum Local Value FF15/FL10

E. Floor Elevation Tolerance Envelope:
   1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
      a. Slab-on-Grade Construction: +/- 3/4"- Typ. U.N.O.

b. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
c. Top surfaces of all other slabs: +/- 3/4"
d. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'-0" at any point, up to 3/4" from theoretical elevation at any point.

3.5 FIELD QUALITY CONTROL

A. Concrete Floor Flatness and Levelness:
1. Measurement Standard: Floors shall be measured for flatness and levelness according to ASTM E1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." Tolerances are specified in Section 033000.
2. Time Period for Measuring and Reporting: All measurements shall be made by the testing laboratory or designated agency before the end of the next workday after the completion of finishing operations. For structural elevated floors, measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete, and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete. The Contractor shall take immediate action to correct any work that is outside the specified tolerances.
3. Measuring Equipment: The concrete surface profile shall be measured using equipment manufactured for the purpose, such as the Dipstick Floor Profiler, as manufactured by the Edward W. Face Company, Norfolk, Virginia, or by other methods specified in ASTM E1155.
4. Floor Test Sections:
a. A floor test section is defined as the smaller of the following areas:
1) The area bounded by column and/or wall lines.
2) The area bounded by construction and/or control joint lines.
3) Any combination of column lines and/or control joint lines.
b. Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines.
c. The precise layout of each test section shall be determined by the testing agency and shall be submitted for the Architect's review and approval.

3.6 REPAIRS

A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.
B. Remedial Measures for Slab Finish Construction not Meeting Specified Tolerances:
1. Application of Remedial Measures. Remedial measures specified herein are required whenever either or both of the following occur:
a. The composite overall values of flatness or levelness of any test section or the entire floor installation measure less than specified values.
b. Any individual test sample (line of measurements) measures less than the specified absolute minimum flatness or levelness value.
2. Modification of Existing Surface:

a. If, in the opinion of the Architect or Owner's representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall immediately undertake the approved repair method.
b. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time required to make the repair.
c. Repair method(s), at the sole discretion of the Architect or Owner's Representative, may include grinding (floor stoning), planing, retopping with specified floor leveling compound, or any combination of the above.
d. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3. Removal and Replacement:
   a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall remove and replace the defective work as directed.
   b. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
   c. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

END OF SECTION

SECTION 03 35 11

CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sealed Concrete Floor: Surface treatments for concrete floors and slabs.
B. Sealed Concrete Walls: Surface treatment for concrete walls at Salt Storage.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer also to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate work with selective demolition, floor patch & repair and construction sequence,

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

1.8 MOCK-UP

A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
B. Mock-Up Size: 10 feet (3 m) square.
C. Locate where directed.
D. Mock-up may remain as part of the work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.10 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
B. Do not finish floors until interior heating system is operational.
C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

1.11 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 COATINGS

A. Penetrating Sealer: Transparent, non-yellowing, water- or solvent-based coating.
   1. Composition: Siloxane.
   2. Products:
      a. Euclid Chemical Company; EUCO-GUARD: www.euclidchemical.com.
      b. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
         1) See article in PART 1 above entitled "Available Manufacturers".
B. Linseed Oil Treatment:
   1. Composition: Blend of boiled linseed oil and solvents.
   2. Products:
      a. Euclid Chemical Company; Linseed Oil Treatment: www.euclidchemical.com.

b. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
    1) See article in PART 1 above entitled "Available Manufacturers".

PART 3 EXECUTION

3.1 CONCRETE FLOOR PREPARATION

A. Remove all glues, adhesives and other foriegn matter from concrete.
B. Patch and repair concrete with products compatible with the concrete and the densifier/hardener.

3.2 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.
B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.3 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.4 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete block.
B. Mortar and grout.
C. Reinforcement and anchorage.
D. Lintels.
E. Accessories.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer also to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections below is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire 2019.
C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement 2016, with Editorial Revision (2018).
D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2018a.
E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2016a.
F. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units 2017.

G. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units 2020a.
H. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
I. ASTM C150/C150M - Standard Specification for Portland Cement 2020.
J. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
K. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
L. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
M. ASTM C476 - Standard Specification for Grout for Masonry 2020.
N. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
O. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength 2019.
P. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar 1992a (Reapproved 2014).
Q. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms 2018.
R. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry 2019a.
S. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry 2014a.
T. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.6 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
D. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
E. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

1.7 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.9 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Manufacturers:
   1. Austin Block and Quarry: www.abaqinc.com.
   2. Best Block: www.bestblock.com.
   3. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

B. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth of 8 inches (200 mm). None N/A
   2. Load-Bearing Units: ASTM C90, normal weight.
      a. Hollow block, as indicated.
      b. Exposed Faces: Manufacturer's standard color and texture where indicated.
   3. Non-Loadbearing Units: ASTM C129.
      a. Hollow block, as indicated.
      b. Medium weight.
   4. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
      a. Performance of Units with Integral Water Repellent:
         1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
            (a) No water visible on back of wall above flashing at the end of 24 hours.
            (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour (0.05 L per hour) at the end of 24 hours.

(c) No more than 25 percent of wall area above flashing visibly damp at end of test.

2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
4) Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.

b. Use only in combination with mortar that also has integral water repellent admixture.
c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.

C. All block installations shall be subject to visual inspections from a distance of 10 feet from the visible masonry surface.
1. This changes the viewing distance mentioned in ASTM C 90 (Standard Specification for Loadbearing Concrete Masonry Units) "Finish and Appearance" section from 20 feet to 10 feet (3.05 m).
2. This shall apply to both loadbearing and non-loadbearing CMU.
3. Visual acceptance/non-acceptance shall be determined by the Architect.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
1. Not more than 0.60 percent alkali.
B. Hydrated Lime: ASTM C207, Type S.
C. Mortar Aggregate: ASTM C144.
D. Grout Aggregate: ASTM C404.
E. Water: Clean and potable.
F. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
1. Use only in combination with masonry units manufactured with integral water repellent admixture.
2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
3. Meet or exceed performance specified for water repellent admixture used in masonry units.
G. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
1. Type: Type N.
2. Color: Standard gray.
3. Water-repellent mortar for use with water repellent masonry units.
H. Masonry Cement is not allowed. No exceptions.
I. Lime substitutes are not allowed. No exceptions.

2.3 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
1. Blok-Lok Limited: www.blok-lok.com/#sle.
2. Hohmann & Barnard, Inc: www.h-b.com/#sle.
3. WIRE-BONDwww.wirebond.com/#sle.

4. Substitutions: See Section 01 2500 - Substitution Procedures AND Section 01 6000 - Product Requirements.
    a. See article in PART 1 above entitled "Available Manufacturers".

B. Single Wythe Joint Reinforcement: ASTM A951/A951M.
1. Type: Ladder.
2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.

C. Strap Anchors: Bent steel shapes, 1-1/2 inch (38 mm) width, 0.105 inch (2.7 mm) thick, 24 inch (610 mm) length, with 1-1/2 inch (38 mm) long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.

2.4 ACCESSORIES

A. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.5 LINTELS

A. Refer to the drawings for lintel schedule.

2.6 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Masonry below grade and in contact with earth: Type S.
2. Exterior, loadbearing masonry: Type N.
3. Exterior, non-loadbearing masonry: Type N.
4. Interior, loadbearing masonry: Type N.
5. Interior, non-loadbearing masonry: Type O.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).

D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.4 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
   3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.
B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
C. Remove excess mortar and mortar smears as work progresses.
D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
E. Interlock intersections and external corners.
F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.6 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6 inches (150 mm).
E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 24 inches (600 mm) horizontally and 24 inches (600 mm) vertically.

3.7 LINTELS

A. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

1. Openings to 42 inches (1070 mm): Place two, No. 3 (M9) reinforcing bars 1 inch (25 mm) from bottom web.
2. Openings from 42 inches (1070 mm) to 78 inches (1980 mm): Place two, No. 5 (M16) reinforcing bars 1 inch (25 mm) from bottom web.
3. Openings over 78 inches (1980 mm): Reinforce openings as detailed.
4. Do not splice reinforcing bars.
5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
6. Place and consolidate grout fill without displacing reinforcing.
7. Allow masonry lintels to attain specified strength before removing temporary supports.

B. Maintain minimum 8 inch (200 mm) bearing on each side of opening.

3.8 GROUTED COMPONENTS

A. Reinforce bond beams with 2, No. 5 (M16) bars, 1 inch (25 mm) from bottom web.
B. Lap splices minimum 24 bar diameters.
C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
D. Place and consolidate grout fill without displacing reinforcing.
E. At bearing locations, fill masonry cores with grout for a minimum 12 inches (300 mm) either side of opening.

3.9 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
C. Form expansion joint as detailed on drawings.

3.10 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
B. Install built-in items plumb, level, and true to line.
C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.
   1. Fill adjacent masonry cores with grout minimum 12 inches (300 mm) from framed openings.
D. Do not build into masonry construction organic materials that are subject to deterioration.

3.11 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch (6 mm).
B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).

F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).
G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

3.12 CUTTING AND FITTING

A. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.13 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.

3.14 CLEANING

A. Remove excess mortar and mortar droppings.
B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with cleaning solution.
D. Use non-metallic tools in cleaning operations.

3.15 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 04 43 13

STONE MASONRY VENEER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Anchored split stone veneer at exterior walls.
B. Metal anchors and accessories for anchored veneer.
C. Setting mortar.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 11 13 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 05 40 00 - Cold-Formed Metal Framing.
C. Section 07 62 00 - Sheet Metal Flashing and Trim: Flashings.
D. Section 07 92 00 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. ASTM A580/A580M - Standard Specification for Stainless Steel Wire 2018.
C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
D. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
E. ASTM C568/C568M - Standard Specification for Limestone Dimension Stone 2015.
F. ASTM C1515 - Standard Guide for Cleaning of Exterior Dimension Stone, Vertical And Horizontal Surfaces, New or Existing 2020.
G. ASTM C1528/C1528M - Standard Guide for Selection of Dimension Stone 2020.

H. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry 2019a.
I. TAS - 2012 Texas Accessibility Standards (TAS) 2012.
J. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on stone units, mortar, and reinforcement.
C. Samples: Submit two stone samples illustrating minimum and maximum stone sizes, color range, texture, and markings.
D. Samples: Submit mortar color samples.

1.7 QUALITY ASSURANCE

A. Provide stone from a United States quarry within a 500 mile (805 km) radius of the project site.
B. Stone Fabricator Qualifications: Company specializing in fabricating cut stone with minimum five years of documented experience.
C. Installer Qualifications: Company specializing in performing work of the type required by this section, with minimum three years of documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect stone from discoloration during storage on site.
B. Provide ventilation to prevent condensation from forming on stone.

1.9 FIELD CONDITIONS

A. Cold Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.
B. Maintain materials and ambient air at minimum of 40 degrees F (5 degrees C) prior to, during, and for 48 hours after completion of work.

1.10 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Stone Quarriers/ Suppliers:
   1. Cobra Stone, Inc.: www.cobrastone.com.
   2. I-10 Building Materials: www.i10buildingmaterials.com.
   3. Mezger Enterprises Ltd: www.mezger.com/#sle.
   4. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

B. Stone Masonry Reinforcement and Accessories - Anchored Veneer:
   1. Hohmann & Barnard, Inc; Tie-HVR-195VB Anchor System: www.h-b.com/#sle.
   2. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

2.2 STONE

A. Stone, General: See recommendations in ASTM C1528/C1528M.

B. Oolitic Limestone: Lueders Limestone; complying with ASTM C568/C568M Classification II - Medium Density.
   1. Grade: ILI Standard.
   2. Color: Sisterdale blend of buff and yellow.
   3. Surface Finish: Roughback.

2.3 MORTAR APPLICATIONS

A. At Contractor's option, mortar may be field-mixed from packaged dry materials or made from factory premixed dry materials with addition of water only.

B. Site-Mixed: ASTM C270, Type N or Type S, using the Proportion Method.
   1. Prepackaged/Preblended: ASTM C1714/C1714M, Type N or Type S.

C. Mortar Color: As selected by Architect.

2.4 MORTAR MIXES

A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
   1. Type: Types as scheduled in this section.
   2. Color: Mineral pigments added as required to produce approved color sample.

B. Mixing: Use mechanical batch mixer and comply with referenced standards.

2.5 ACCESSORIES - ANCHORED VENEER

A. Wall Ties: Formed steel wire, at least 3/16 inch (4.8 mm) diameter, stainless steel complying with ASTM A580/A580M, adjustable anchor system, with provision for vertical adjustment after attachment.

B. Other Anchors in Direct Contact with Stone: ASTM A666 Type 304, stainless steel, of sizes and configurations required for support of stone and applicable superimposed loads.

C. Flashings: As specified in Section 07 62 00.
D. Cleaning Solution: Type that will not harm stone, joint materials, or adjacent surfaces.

2.6 STONE FABRICATION - ANCHORED VENEER

A. Nominal Thickness: 4 inch (100 mm).
B. Pattern and Coursing: As shown on the drawings.
C. Fabricate for 3/8 inch (10 mm) beds and joints.
D. Bed and Joint Surfaces:
   1. Cut or sawn full square for full thickness of unit.
E. Backs: Rough or split.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that support work and site conditions are ready to receive work of this section.

3.2 PREPARATION - ANCHORED VENEER

A. Establish lines, levels, and coursing. Protect from disturbance.
B. Clean stone prior to installation. Do not use wire brushes or implements that mark or damage exposed surfaces.
C. Clean sawn surfaces of rust stains and iron particles.

3.3 INSTALLATION - ANCHORED VENEER

A. Install flashings of longest practical length and seal watertight to back-up. Lap end joints minimum 6 inches (150 mm) and seal watertight.
B. Size stone units to fit opening dimensions and perimeter conditions.
C. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.
D. Arrange stone pattern to provide color uniformity and minimize visual variations , and provide a uniform blend of stone unit sizes.
E. Arrange stone coursing in ashlar bond with consistent joint width.
F. Set stone in full mortar setting bed to fully support stone over bearing surface. Use setting buttons or shims to maintain correct joint width.

3.4 REINFORCEMENT AND ANCHORAGE - ANCHORED VENEER

A. Attach wall ties to back-up to bond veneer to back-up at maximum 16 inches (400 mm) on center vertically and 16 inches (400 mm) on center horizontally.
B. In addition, place wall ties at maximum 3 inches (75 mm) on center each way around perimeter of openings, within 12 inches (300 mm) of openings.

3.5 JOINTS - ANCHORED VENEER

A. Leave the following joints open for sealant specified in Section 07 92 00:
   1. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
   2. Joints below ledge and relieving angles.
   3. Joints labeled "expansion joint".
B. Pack mortar into joints and work into voids. Neatly tool surface to concave joint.
C. At joints to be sealed, clean mortar out of joint before it sets. Brush joints clean.

3.6 INSTALLATION - MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
B. Extend metal flashings through exterior face of stone and terminate in an angled drip with hemmed edge.
C. Lap end joints of flashings at least 6 inches (152 mm), minimum, and seal watertight with flashing sealant/adhesive.

3.7 CONTROL AND EXPANSION JOINTS

A. Form joints as detailed on drawings.

3.8 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.
B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
C. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet (6 mm in 3 m) and 1/2 inch in 20 feet (13 mm in 6 m) or more.
D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
E. Maximum Variation from Level Coursing: 1/8 inch in 3 feet (3 mm in 1 m) and 1/4 inch in 10 feet (6 mm in 3 m); 1/2 inch in 30 feet (13 mm in 9 m).
F. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet (3 mm in 1 m).

3.9 CLEANING

A. Remove excess mortar as work progresses, and upon completion of work.
B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with cleaning solution.
D. Clean exterior stone per ASTM C1515.
E. Use non-metallic tools in cleaning operations.

3.10 PROTECTION

A. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

END OF SECTION

SECTION 04 72 00

CAST STONE MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Architectural cast stone.
B. Units required are:
   1. Exterior wall units, including wall caps, lintels, sills, and medallions.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 04 43 13 - Stone Masonry Veneer : Installation of cast stone in conjunction with masonry veneer.
C. Section 07 92 00 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary 2014 (Errata 2018).
B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
C. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement 2019.
D. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement 2019, with Editorial Revision (2020).
E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2018a.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2018.
G. ASTM C150/C150M - Standard Specification for Portland Cement 2020.
H. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
I. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019.
J. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
K. ASTM C1364 - Standard Specification for Architectural Cast Stone 2019.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Test results of cast stone components made previously by the manufacturer.
C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.
D. Verification Samples: Pieces of actual cast stone components not less than 6 inches (152 mm) square, illustrating range of color and texture to be anticipated in components furnished for the project.
E. Source Quality Control Test Reports.
F. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:
    1. A firm with a minimum of 5 years experience producing cast stone of types required for project.
    2. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
B. Number each piece individually to match shop drawings and schedule.
C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
F. Store mortar materials where contamination can be avoided.
G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

1.8 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Architectural Cast Stone:
   1. Any current producer member of the Architectural Precast Association.
   2. Any current producer member of the Cast Stone Institute.
   3. Continental Cast Stone Manufacturing, Inc.: www.continentalcaststone.com.
   4. Stromberg Architectural: www.strombergarchitectural.com.
   5. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

2.2 ARCHITECTURAL CAST STONE

A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural limestone, complying with ASTM C1364.
   1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
   2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
   3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet (6 meters).
   4. Color: Selected by Architect from manufacturer's full range.
   5. Remove cement film from exposed surfaces before packaging for shipment.

B. Shapes: Provide shapes indicated on drawings.
   1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
   2. Unless otherwise indicated on drawings, provide:
      a. Wash or slope of 1:12 on exterior horizontal surfaces.
      b. Drips on projecting components, wherever possible.

c. Raised fillets at back of sills and at ends to be built in.

C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.

2.3 MATERIALS

A. Portland Cement: ASTM C150/C150M.
   1. For Units: Type I, white or gray as required to match Architect 's sample.
   2. For Mortar: Type I or II, except Type III may be used in cold weather.
B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
D. Pigments: ASTM C979, inorganic iron oxides; do not use carbon black.
E. Admixtures: ASTM C494/C494M.
F. Water: Potable.
G. Reinforcing Bars: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed bars, galvanized.
   1. Galvanized in accordance with ASTM A767/A767M, Class I.
H. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
I. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
J. Mortar: Portland cement-lime, ASTM C270 Type N ; do not use masonry cement.
K. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.
B. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 20 00.
B. Mechanically anchor cast stone units indicated; set remainder in mortar.
C. Setting:
   1. Drench cast stone components with clear, running water immediately before installation.
   2. Set units in a full bed of mortar unless otherwise indicated.
   3. Fill vertical joints with mortar.
   4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.3 TOLERANCES

A. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.

1. Leave the following joints open for sealant:
    a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
    b. Joints in projecting units.
    c. Joints between rigidly anchored units, including soffits, panels, and column covers.
    d. Joints below lugged sills and stair treads.
    e. Joints below ledge and relieving angles.
    f. Joints labeled "expansion joint".

B. Installation Tolerances:
1. Variation from Plumb: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
2. Variation from Level: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
3. Variation in Joint Width: Not more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch (1.5 mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.4 REPAIR

A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet (6 m).
1. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.
2. Repair methods and results subject to Architect 's approval.

3.5 CLEANING

A. Keep cast stone components clean as work progresses.

3.6 PROTECTION

A. Protect completed work from damage.
B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formed steel stud exterior wall and shop wall framing.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 06 10 00 - Rough Carpentry: Wood blocking and miscellaneous framing.
C. Section 07 21 00 - Thermal Insulation: Insulation within framing members.
D. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2018).
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021.
E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.

F. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
C. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
D. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
E. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
    1. Describe method for securing studs to tracks and for bolted framing connections.
    2. Design data:
        a. Shop drawings signed and sealed by a professional structural engineer.
F. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention .
G. Designer's Qualification Statement.
H. Manufacturer's Qualification Statement.
I. Buy American Certification: Upon delivery of product, provide notarized original of TxDOT Form 1818 (aka Form D-9-USA-1) with the proper attachments for verification of compliance.

1.7 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in TEXAS.
B. Buy America: Manufacturer shall provide products complying with the latest provisions of Buy America as listed at 23 CFR 635.410. For steel and iron materials, all manufacturing processes, including application of a coating, must occur in the United States.
C. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.8 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of

specified manufacturers' data is grounds for disapproval.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Framing:
   1. CEMCO: www.cemcosteel.com/#sle.
   2. ClarkDietrich: www.clarkdietrich.com/#sle.
   3. Marino: www.marinoware.com/#sle.
   4. SCAFCO Corporation: www.scafco.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Framing Connectors and Accessories:
   1. Same manufacturer as metal framing.
   2. Simpson Strong Tie: www.strongtie.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide completed framing system having the following characteristics:
   1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100.
   2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
   3. Design Loads: In accordance with applicable codes.
   4. Live load deflection meeting the following, unless otherwise indicated:
      a. Exterior Walls and Full-Height Shop Walls: Maximum horizontal deflection under wind load of 1/600 of span.
      b. Design non-axial loadbearing framing to accommodate not less than 1/2 in (13 mm) vertical deflection.
   5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

C. Shop fabricate framing system to the greatest extent possible.

D. Deliver to project site in largest practical sections.

2.3 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
   1. Gauge: As required to meet specified performance levels for depth indicated.
   2. Stud Depth: As indicated on drawings.

3. Galvanized in accordance with ASTM A653/A653M, G60/Z180 coating.
4. Provide components fabricated from ASTM A1008/A1008M Designation SS (structural steel).

B. Zee Furring at exterior where indicated on the drawings shall be galvanized and a minimum of 18 gage (43 mils (0.0428 inches) (1.087 mm)) thick, unless required to be heavier. Galvanized in accordance with ASTM A 653/A 653M G60/Z180 coating.

C. Framing Connectors: Factory-made, formed steel sheet.
1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G60/Z180 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch (3.42 mm), and factory punched holes and slots.
2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100.
3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections where indicated on the drawings.

2.4 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.

B. Anchorage Devices: Powder actuated.

2.5 ACCESSORIES

A. Sill Gasket on Top of Foundation between the top of the foundation and the galvanized metal floor channel along the exterior perimeter of the building: 5½ ” W x 50’ L x 1/4 inch (6 mm) thick, plate width, closed cell plastic foam from continuous rolls.
1. Dow Chemical Co.; Product - Styrofoam Sill Seal polyethylene gasketing strip: www.dow.com.
2. Owens Corning Corp.; Product - FoamSealR sill plate gasket: www.owenscorning.com.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.2 INSTALLATION OF STUDS

A. Install components in accordance with ASTM C1007 requirements and ASTM C1007 requirements.
B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches (600 mm) on center. Coordinate installation of sealant with floor and ceiling tracks.
C. Place studs at 16 inches (400 mm) on center; not more than 2 inches (50 mm) from abutting walls and at each side of openings. Connect studs to tracks using fastener method.
D. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
E. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.
F. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
G. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
H. Attach cross studs to studs for attachment of fixtures anchored to walls.
I. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
J. Touch-up field welds and damaged galvanized surfaces with primer.

3.3 INSTALLATION OF WALL SHEATHING

A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
    1. Provide steel diagonal bracing at corners with foam insulation or gypsum board wall sheathing.

3.4 TOLERANCES

A. Maximum Variation from True Position: 1/4 inch (6 mm).
B. Maximum Variation of any Member from Plane: 1/4 inch (6 mm).

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel items.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
C. Section 04 43 13 - Stone Masonry Veneer: Placement of metal fabrications in masonry.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
C. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.
D. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2014.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.
H. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).
J. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.6 QUALITY ASSURANCE

A. Design structural items under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in TEXAS.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.
B. Steel Tubing:
   1. ASTM A501/A501M, hot-formed structural tubing.
C. Plates: ASTM A283/A283M.
D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
E. Slotted Channel Framing:
   1. ASTM A1011/A1011M, Grade 33.
F. Bolts, Nuts, and Washers:
   1. ASTM A325, Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Continuously seal joined members by continuous welds.
D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
B. Lintels: As detailed; prime paint finish.
C. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.

2.4 FINISHES - STEEL

A. Prime Painting: One coat.

2.5 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Prepare substrate as recommended by manufacturer for cold galvanizing compound.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components as indicated on drawings.
D. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Obtain approval prior to site cutting or making adjustments not scheduled.
F. After erection, prime welds, abrasionsand surfaces not shop primed or galvanized , except surfaces to be in contact with concrete.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

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. Framing with dimension lumber.
   2. Framing with engineered wood products.
   3. Shear wall panels.
   4. Wood blocking and nailers.

B. Related Requirements:
   1. Section 06 16 00 "Wood Sheathing."
   2. Section 06 17 53 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NeLMA: Northeastern Lumber Manufacturers' Association.
   2. NLGA: National Lumber Grades Authority.
   3. RIS: Redwood Inspection Service.
   4. SPIB: The Southern Pine Inspection Bureau.
   5. WCLIB: West Coast Lumber Inspection Bureau.
   6. WWPA: Western Wood Products Association.

1.4 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 wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
   4. Retain "Fastener Patterns" Paragraph below for exposed framing if fastener locations are critical to appearance and fastener patterns are not shown on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated wood.
   2. Shear panels.
   3. Power-driven fasteners.
   4. Powder-actuated fasteners.
   5. Expansion anchors.
   6. Metal framing anchors.

1.6 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.

1.7 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. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
   1. 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.
   2. Factory mark each piece of lumber with grade stamp of grading agency.
   3. In DOC PS 20, dressed sizes of green lumber are larger than dry lumber.
   4. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   5. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: As indicated on drawings.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
   2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

B. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
   1. Retain first option and delete list that follows if all rough carpentry must be treated with wood preservative.

C. Application: Treat items indicated on Drawings, and the following**:**
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
   3. Wood floor plates that are installed over concrete slabs-on-grade.
   4. Insert other items that require treatment but are not likely to be indicated on Drawings.

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. Cants.
   4. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber and any of the following species:
   5. Mixed southern pine; SPIB.
   6. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   7. Delete first paragraph below if not acceptable.

B. 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.

C. 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.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-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 rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
B. Nails, Brads, and Staples: ASTM F 1667.
C. Power-Driven Fasteners: NES NER-272.
D. Wood Screws: ASME B18.6.1.
E. Lag Bolts: ASME B18.2.1.
F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
D. 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**.**
E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.
F. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
H. Do not splice structural members between supports unless otherwise indicated.
I. 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.
   2. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   3. Use inorganic boron for items that are continuously protected from liquid water.
   4. Use copper naphthenate for items not continuously protected from liquid water.
J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.

2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Revise first paragraph below to include other kinds of nails if required.

K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
   1. Indicate locations of other fasteners, such as wood screws, bolts, and lag screws, on Drawings.

3.2 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.
   1. For exterior walls, provide 2-by-6-inch nominal size wood studs spaced 16 inches o.c. unless otherwise indicated.
   2. For interior partitions and walls, provide 2-by-6-inch nominal size wood studs spaced 16 inches o.c. unless otherwise indicated.
   3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.

B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
   1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
   2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

END OF SECTION

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preservative treated wood materials.
B. Fire retardant treated wood materials.
C. Communications and electrical room mounting boards.
D. Concealed wood blocking, nailers, and supports.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
C. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.
D. PS 1 - Structural Plywood 2009 (Revised 2019).
E. PS 20 - American Softwood Lumber Standard 2020.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.2 CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards, Plywood at MDF Room and Shops where indicated on plans: PS 1, A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
B. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
   3. Other Locations: PS 1, C-D Plugged or better.

2.3 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2.4 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
   1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature, low hygroscopic type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat rough carpentry items as indicated.
      c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.10 lb/cu ft retention (to 1.6 kg/cu m retention).
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber in contact with roofing, flashing, or waterproofing.
      c. Treat lumber in contact with masonry or concrete.
      d. Treat lumber less than 18 inches (450 mm) above grade.
      e. Treat lumber in other locations as indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
D. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.

4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Chalkboards and marker boards.

3.4 INSTALLATION OF CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.
   4. Size and Location: As indicated on drawings.

3.5 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
B. Allow preservative to dry prior to erecting members.

3.6 CLEANING

A. Waste Disposal:
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 1600
WOOD SHEATHING

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. Wall sheathing.
   2. Roof sheathing.

B. Related Requirements:
   1. Section 06 10 00 "Rough Carpentry" for plywood backing panels.

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.

1.4 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.

1.5 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 WOOD PANEL PRODUCTS

A. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.

B. Oriented Strand Board: DOC PS 2.

C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

D. Factory mark panels to indicate compliance with applicable standard.

2.2 WALL SHEATHING

A. Plywood Wall Sheathing: Includes OSB products that carry an approval by the American Plywood Associations (APA Rating)
   1. Nominal Thickness: As indicated on Drawings

2.3 ROOF SHEATHING

A. Plywood Roof Sheathing: Includes OSB products that carry an approval by the American Plywood Associations (APA Rating)
   1. Nominal Thickness: As indicated on Drawings.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
E. Coordinate wall 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.
F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
G. 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 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
      b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION

SECTION 06 17 53
SHOP-FABRICATED WOOD TRUSSES

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. Wood roof trusses.
   2. Metal truss accessories.

B. Related Sections include the following:
   1. Division 06 Section "Wood Sheathing" for roof sheathing and subflooring.

1.3 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

B. TPI: Truss Plate Institute, Inc.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NeLMA: Northeastern Lumber Manufacturers' Association.
   2. NLGA: National Lumber Grades Authority.
   3. SPIB: The Southern Pine Inspection Bureau.
   4. WCLIB: West Coast Lumber Inspection Bureau.
   5. WWPA: Western Wood Products Association.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
   1. Design Loads: As indicated.
   2. Maximum Deflection Under Design Loads:
      a. Roof Trusses: Vertical live load deflection of 1/240 of span.

1.5 SUBMITTALS

A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
   1. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.

B. Shop Drawings: Shall bear the seal of a Professional Engineer registered to practice in the State of Texas. Show fabrication and installation details for trusses.

1. The truss shop drawings shall be submitted to the structural engineer prior to fabrications. A final set of coordinated design drawing and layout shall be furnished to the engineer prior to erection.
2. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
3. Indicate sizes, stress grades, and species of lumber.
4. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates. Include name of metal connector plate manufacturer.
6. All truss-to-truss and truss-to-beam connections shall be designed and supplied by the truss manufacturer. All beam-to-truss connections shall be provided by the engineer of record.
7. Show splice details and bearing details.
8. Indicate design loads and all allowable unit stress increases, where applicable. Design loadings shall include maximum wind speeds, exposure and snow loading.
9. Web and chord members shall indicate Tension and/or Compression forces for applicable design loading.
10. All point loads shall be specified and indicated.
11. Indicate resultant forces at bearings, reactions and uplift forces.
12. All members requiring permanent bracing shall be indicated on the design cut sheets.
13. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.

D. Qualification Data: For metal-plate manufacturer, fabricator and Installer.

E. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

F. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Metal-plate connectors.
2. Metal truss accessories.

1.6 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

C. Source Limitations for Connector Plates: Obtain metal connector plates from a single manufacturer.

D. Comply with applicable requirements and recommendations of the following publications:
   1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
   2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
   3. TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."

E. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations of TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."
   1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
   2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
   3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

1.8 COORDINATION

A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

PART 2 - PRODUCTS

2.1 DIMENSION LUMBER

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. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
   3. Provide dressed lumber, S4S.
   4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

B. Grade and Species: For truss chord and web members, provide dimension lumber of any species, graded visually or mechanically, and capable of supporting required loads without exceeding

allowable design values according to AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

C. The size and configuration of the web and chord members shall be determined by the truss manufacturer.
   1. Roof truss designs shall be based on triangulated interior web configuration.

D. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Division 06 Section Rough Carpentry.

2.2 METAL CONNECTOR PLATES

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Alpine Engineered Products, Inc.
   2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
   3. CompuTrus, Inc.
   4. Eagle Metal Products.
   5. Jager Building Systems, Inc.
   6. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc.
   7. Robbins Engineering, Inc.
   8. TEE-LOK Corporation; a subsidiary of Berkshire Hathaway Inc.
   9. Truswal Systems Corporation.

C. General: Fabricate connector plates to comply with TPI 1.

D. Stainless-Steel Sheet: ASTM A 666, Type 304 or 316, and not less than 0.035 inch thick.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.4 METAL TRUSS ACCESSORIES

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following:
   1. Cleveland Steel Specialty Co.
   2. Harlen Metal Products, Inc.
   3. KC Metals Products, Inc.
   4. Simpson Strong-Tie Co., Inc.
   5. Southeastern Metals Manufacturing Co., Inc.
   6. USP Structural Connectors.

D. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

E. Stainless-Steel Sheet: ASTM A 666, Type 304 or 316.

F. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches wide by 1 inch deep by 0.040 inch thick, made to fit between 2 adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

2.5 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
   1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press. Dead knots and wanes on lumber shall not be present under the connector plates.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.

G. Anchor trusses securely at bearing points; use metal truss tie-downs as applicable. Install fasteners through each fastener hole in truss accessories according to manufacturer's fastening schedules and written instructions.

H. Securely connect each truss ply required for forming built-up girder trusses.

1. Anchor trusses to girder trusses as indicated.

I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
   1. Install bracing to comply with Division 06 Section Rough Carpentry.

J. Install wood trusses within installation tolerances in TPI 1.

K. Do not cut or remove truss members.

L. Replace wood trusses that are damaged or do not meet requirements.
   1. All truss repairs made in the field shall be documented by the contractor. A signed and sealed repair shall be required for all repairs.
   2. Field notching or cutting of truss is prohibited. All modifications shall be made under the direct supervision of the truss design engineer.

3.2 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.
   1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

END OF SECTION

SECTION 06 41 00

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Specially fabricated cabinet units.
B. Countertops.
C. Hardware.
D. Factory finishing.
E. Preparation for installing utilities.
F. Caulking.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 11 13 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
C. Section 06 10 53 - Miscellaneous Rough Carpentry: Mounting boards, concealed wood blocking, nailers, and supports.
D. Section 07 92 00 - Joint Sealants - Joint sealers, paint grade caulk.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications 2016.
B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).
D. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.

E. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
F. TAS - 2012 Texas Accessibility Standards (TAS) 2012.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
   2. Complete details of materials and installation; combine with shop drawings of cabinets and casework and countertop materials specified herein or in other sections.
C. Product Data:
   1. Provide data for hardware accessories.
   2. Color matched caulk product data
D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches (300 mm) square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
B. Work of this Section shall comply with the TAS.
   1. TAS covers scoping and technical requirements for accessibility to sites, facilities, buildings, and elements by individuals with disabilities in the state of Texas.

1.8 MOCK-UP

A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware and finishes.
B. See Section 01 40 00 - Quality Requirements for additional requirements.
C. Locate where directed.
D. Mock-up may remain as part of the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.10 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

1.11 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets:
   1. Finish - Exposed Exterior Surfaces: Decorative laminate.
   2. Finish - Exposed Interior Surfaces: Decorative laminate.
   3. Finish - Semi-Exposed Surfaces: Decorative laminate
   4. Finish - Concealed Surfaces: Manufacturer's option.
   5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
   6. Casework Construction Type: Type A - Frameless.
   7. Interface Style for Cabinet and Door: Style 1 - Overlay; flush overlay.
   8. Drawer Construction Technique: Dovetail joints.

2.2 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

B. Particleboard / Particle Board is not allowed. Use MDF or MR MDF in lieu of particleboard.

C. Medium Density Fiberboard (MDF): ANSI A208.2 ; type as specified in AWI/AWMAC/WI (AWS); composed of wood fibers pressure bonded with moisture resistant adhesive to suit application; sanded faces; thickness as required.

2.3 LAMINATE MATERIALS

A. Manufacturers:
   1. Formica Corporation: www.formica.com/#sle.
   2. Panolam Industries International, Inc: www.panolam.com/#sle.
   3. Wilsonart LLC: www.wilsonart.com/#sle.
   4. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

2.4 COUNTERTOPS

A. Plastic Laminate Countertops: Medium density fiberboard substrate covered with HPDL, conventionally fabricated and self-edge banded.
   1. Use moisture-resistant MDF at countertops with sinks.

2.5 ACCESSORIES

A. Color Matched Caulk: Provide factory color matched siliconized latex caulk.
   1. Color: As selected by Architect to match material(s) identified by Architect.
B. Adhesive: Type recommended by fabricator to suit application.
C. Fasteners: Size and type to suit application.
D. Grommets: Plastic grommets with cord slot cover, for cut-outs, in color as indicated.
   1. Basis of Design Product: Doug Mocket & Company; XG Flip-Top Series: www.mockett.com.

2.6 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified and as indicated below.
B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards and coordinated self rests, polished chrome finish, for nominal 1 inch (25 mm) spacing adjustments.
C. Fixed Specialty Workstation and Countertop Brackets:
   1. Material: Steel.
   2. Finish: Manufacturer's standard, factory-applied powder coat.
   3. Color: Selected by Architect from manufacturer's standard range.
   4. Manufacturers:
      a. Basis of Design Product: "Concealed" and "Extended Concealed" Work Station Brackets by A&M Hardware, Inc; http://www.aandmhardware.com/#sle.
      b. Rakks/Rangine Corporation; Inside Wall Flush Mount Brackets: www.rakks.com/#sle
      c. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
         1) See article in PART 1 above entitled "Available Manufacturers".
D. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers ("U" shaped wire pull, steel with chrome finish, 100 mm centers).
E. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Heavy Duty grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Manufacturers:
      a. Accuride International, Inc; Heavy-Duty Drawer Slides: www.accuride.com/#sle.
      b. Knape & Vogt Manufacturing Company; Heavy-Duty Drawer Slides: www.knapeandvogt.com/#sle.

c. Substitutions: Submit selection(s) for Architects review, compliant with Section 01 2500 - Substitution Procedures and Section 01 6000 - Product Requirements.
   1) See article in PART 1 above entitled "Available Manufacturers".

F. Hinges: European style concealed self-closing type, steel with nickel-plated finish.

2.7 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
C. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.
B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.
D. Secure cabinets to floor using appropriate angles and anchorages.
E. Clean and prepare locations to be caulked including, but not limited to countertops, backsplashes, side splashes, cabinets, vanities and adjoining surfaces.
   1. Apply color matched caulk at countertop material locations as recommended by manufacturer.
   2. Apply paint grade caulk at non-countertop material locations as recommended by manufacturer.

3.3 ADJUSTING

A. Adjust installed work.
B. Adjust moving or operating parts to function smoothly and correctly.
C. Replace damaged items.

3.4 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board insulation at cavity wall construction.
B. Batt insulation in exterior wall construction.
C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
C. Section 05 40 00 - Cold-Formed Metal Framing:
D. Section 07 21 16 - Pre-Engineered Building Blanket Insulation: Insulation liner system at pre-engineered metal building framing.
E. Section 07 27 20 - Membrane Flashing
F. Section 07 27 26 - Fluid-Applied Membrane Air Barrier

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.
B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C 2019a.
E. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components 2019.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.6 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.7 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Insulation Over Metal Stud Framed Walls, Continuous: Extruded polystyrene (XPS) board.
B. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

2.2 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
   4. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.

5. Board Size: 48 x 96 inch (1220 x 2440 mm).
6. Board Thickness: 1-1/2 inches (37.5 mm).
7. Board Edges: Square.
8. Thermal Resistance: R-value of 5.0, minimum per 1 inch (25.4 mm) at 75 degrees F (24 degrees C) mean temperature.
9. Compressive Resistance: 25 psi (173 kPa).
10. Board Density: 1.60 lb/cu ft (26 kg/cu m).
11. Manufacturers:
    a. Dow Chemical Company: www.dowbuildingsolutions.com/#sle.
    b. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
    c. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
        1) See article in PART 1 above entitled "Available Manufacturers".

2.3 BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
2. Formaldehyde Content: Zero.
3. Facing: Unfaced.
4. Manufacturers:
    a. CertainTeed Corporation: www.certainteed.com/#sle.
    b. Johns Manville: www.jm.com/#sle.
    c. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
5. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
    a. See article in PART 1 above entitled "Available Manufacturers".

C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
3. Manufacturers:
    a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
    b. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.
    c. Thermafiber, Inc; SAFB: www.thermafiber.com/#sle.
    d. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
        1) See article in PART 1 above entitled "Available Manufacturers".

2.4 ACCESSORIES

A. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
B. Verify substrate surfaces are flat, free of irregularities or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT EXTERIOR WALLS

A. Apply adhesive to back of boards:
B. Install boards horizontally on walls.
    1. Place boards to maximize adhesive contact.
    2. Install in running bond pattern.
    3. Butt edges and ends tightly to adjacent boards and protrusions.
C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.
B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.4 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 21 16

PRE-ENGINEERED BUILDING BLANKET INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulation system for pre-engineered metal buildings.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
C. Section 10 81 13 - Bird Net: Bird protection at Wash Bay.
D. Section 13 34 19 - Metal Building Systems.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards current edition.
B. ASTM C991 - Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings 2016.
C. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation 2021.
D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
F. NAIMA 202 - Standard for Flexible Fiberglass Insulation to be Laminated for Use in Metal Buildings 96(R) (Rev. 2000).

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of insulation system with size, location and installation of service utilities.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data for each of the following including:
   1. Roof installation instructions.
   2. Wall installation instructions.
   3. Product data sheet.
   4. Design considerations guide.
C. Shop Drawings: Indicate the following:
   1. Liner fabric layout.
   2. Insulation Layout and cut list.
   3. Customer and project information.
D. Samples: Submit two samples of each finish product, 6 by 6 inch (150 by 150 mm) in size, illustrating material, color, and finish.
E. Certificate: Certify that products of this section meet or exceed specified requirements.
F. Manufacturer's Qualification Statement.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products indoors or in a dry, covered area.
B. Do not open products until ready to use.
C. Protect products from potential construction site damage.
D. Use care when opening products as pallets may shift during shipment.
E. Banding has sharp edges. Wear cut proof gloves when handling.
F. Wear safety glasses when unpacking materials.

1.9 FIELD CONDITIONS

A. Do not install this system outside of the temperature, humidity, ventilation and environmental limits recommended by the manufacturer. Products should be kept covered and dry at temperatures less than 100°F prior to installation.

1.10 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal,

however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.

1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Owens Corning Insulating Systems, LLC; OptiLiner Banded Liner System: www.owenscorning.com.
B. Thermal Design, Inc.; Simple Saver System: www.thermaldesign.com.
C. Substitutions: See Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
   1. See article in PART 1 above entitled "Available Manufacturers".

2.2 MATERIALS

A. Unfaced light density fiberglass metal building insulation; ASTM C991, Type 1:
   1. Complies with NAIMA 202 .
   2. Thermal Resistance: R13 at walls and R19 + R11 (R30 for full cavity) at roof.
   3. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 50 or less, when tested in accordance with ASTM E84.
   4. VOC Content: As specified in Section 01 61 16 .
B. Fabric liner facing/vapor barrier composed of woven high-density polyethylene coated on both sides with polyethylene:
   1. Complies with ASTM C1136 , Types I through VI.
      a. Type I-IV exception for dimensional stability (value is less than 2.0%.).
   2. Perm Rating: 0.02 or less when tested in accordance with ASTM E96/E96M , Procedure A.
   3. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 50 or less, when tested in accordance with ASTM E84.
   4. Color: White.

2.3 ACCESSORIES

A. Vapor Barrier Adhesive: Manufacturer's recommended adhesive.
   1. Application Temperature: 10 degrees F to 110 degrees F.
B. Double Sided Vapor Barrier Tape: Rubber based and free film.
   1. Width: 0.75 inch (19 mm).
C. Patch Tape:
   1. Adhesive added to one side.
   2. Installation Temperature: 10 degrees F to 110 degrees F.

3. Width: 3 inches (76 mm).

D. Metal Banding/Straps: Coated steel.
   1. Width: 1.0 inch (25 mm).
   2. Structural Steel Grade 50.
   3. Exposed color to match vapor barrier.

E. Thermal Breaks:
   1. Closed cell polyethylene foam tape for wall applications:
      a. Thickness: 0.125 to 0.375 inch (3.2 to 9.5 mm).
      b. Width: 3 inches (76 mm).
   2. Thermal spacer blocks: Extruded or expanded polystyrene.
      a. Width: 3 inches (76 mm) minimum.
      b. Thickness: 0.5 to 1.0 inch (13 to 25 mm).

F. Light Gage Steel Fasteners:
   1. Zinc plated cold forged steel.
   2. Head color to match vapor barrier.
   3. Contain rubber sealing washer.

G. Heavy Gage Steel Fasteners:
   1. Zinc plated cold forged steel.
   2. Head color to match vapor barrier.
   3. Contain rubber sealing washer.

H. Insulation Hangars: Galvanized steel insulation support system with 2-1/2 inch (63.5 mm) arrow prongs that holds the insulation.
   1. Product: Insul-Hold by JR Metal Frames Manufacturing, Inc.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine the areas and conditions under which work of this section will be installed. Verify that adjacent materials are dry and ready to receive insulation. Verify structure, bracing, and concealed building systems have been tested and inspected.

B. Provide written report listing conditions detrimental to performance of work in this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install liner system in accordance with manufacturer’s written installation instructions and approved Shop Drawings.

B. Purlin and girt attachment surfaces should be clean and dry prior to attaching two-faced tape or sealing adhesive.

C. Installed fiberglass insulation should fit snugly against purlin and girt walls in the cavity space. Avoid gaps, voids and any excess compression.

D. Interface With Other Work:
   1. Coordinate installation with bird netting where indicated.

3.3 CLEANING

A. Clean dirt from vapor barrier fabric using a soft cloth with soap and water or non-abrasive household cleaner. Solvent-based cleaners and abrasive pads should be avoided.

3.4 SAFETY PRECAUTIONS

A. Installation contractor must have a site-specific safety plan and comply with all OSHA applicable local rules and regulations when installing this system.
B. Workers must use OSHA required fall protection when installing the banded liner system at heights (see OSHA regulations at 29 CFR 1926, Subpart M).
C. Banding has sharp edges and cut proof gloves should be worn when handling

END OF SECTION

SECTION 07 27 20

MEMBRANE FLASHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Membrane Flashing (may also be referred to as "Transition Flashing", "Tape Flashing", or "Wall Penetration Flashing"): a self-adhering air and moisture barrier tape for use on vertical and horizontal above grade substrates and most construction surfaces around window, door frame, vent and other wall penetration elements.
   1. Must be compatible with the products used in 07 27 26 - Fluid Applied Membrane Air Barrier.

B. NOTE: The materials in this Section are NOT Through-Wall Flashing.

1.2 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 07 27 26 - Fluid Applied Membrane Air Barrier
C. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with air barriers.
D. Section 07 92 00 - Joint Sealants.
E. Section 09 21 16 - Gypsum Board Assemblies.

1.3 DEFINITIONS

A. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification (for wall penetration sealing only), vapor impermeable air barriers are classified as vapor retarders.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. Compliance with these standards is a requirement of the work.
B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2020.
C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
D. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials 2017.
E. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing 2015.

1.5 SUBMITTALS

A. Product Data: Provide data on material characteristics, performance criteria, limitations, and the following:
   1. Written certification that product(s) is(are) compatible with the products of Section 07 2728 Fluid-Applied Air Barrier Assembly.

B. Shop Drawings: Provide drawings of special joint conditions.
C. Manufacturer's Installation Instructions: Indicate preparation.

1.6 MOCK-UP

A. Install Membrane Flashing at wall system Mock-Ups.

1.7 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.1 MEMBRANE FLASHING (Wall Penetration Flashing)

A. General Performance Requirements
   1. Polyester backed synthetic butyl rubber based adhesive membrane that can be applied to gypsum board, roofing membranes, steel, concrete, building paper, block wall, insulation board, plywood, metal, polystyrene and polyethylene surfaces to form a positive and immediate moisture and vapor barrier protection system.
   2. Conformability characteristics to irregular surfaces, low temperature adhesion and high temperature flow stability.
   3. Compatible with EPDM, PVC, modified bitumen, cured asphalt & coal tar pitch.
   4. Additional requirements and general applications:
      a. Tested and proven not to flow at elevated temperatures up to 300°F (149°C).
      b. Sheet rock joints in roof assemblies
      c. Sealing joints on gypsum sheathing in cavity wall construction
      d. Window & door perimeters to the building substrate
      e. Joints on synthetic stucco systems.
      f. Other areas where a moisture, vapor or air barrier is required
      g. Applications on surfaces as cold as 25°F (-3.8°C) or above
      h. All critical high-temperature applications where a moisture, vapor or air barrier is required.
      i. Self-adhesive sheet flashing complying with ASTM D1970/D1970M.
      j. Water Vapor Permeance: 0.05 perm (2.87 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M.
      k. Water resistive barrier complying with ICC-ES AC212.
      l. Flexible flashing material compliant with ICC-ES AC148.

B. Technical Data
   1. Color: Any color as long as it is compatible with all other materials over which it is used and complies with performance requirements.
   2. Thickness: 40 mils ± 5 mils.
   3. Tensile Strength: 150 psi (1.04 Mpa).
   4. Elongation (ultimate failure of butyl mass): 500% min.
   5. Permeance: (.013) avg perms.
   6. In-Service Temperature: -30°F to 250°F (-34°C to 121°C).

C. Air Barrier:

1. Refer to Section 07 27 26 - Fluid Applied Membrane Air Barrier
2. On outside surface of inside wythe of exterior masonry cavity walls use air barrier coating.

D. Product: Membrane / transition flashing:
1. UT-40 Universal Tape as manufactured by STS Coatings, Inc., 347 Hwy 289, Comfort, TX 78013; T:(830) 995-5177; F: (830) 995-5705; Web Site: www.stscoatings.com
2. SikaMultiSeal 515, Self-Adhered Transition Seam Tape, as manufactured by Sika Corporation; Lyndhurst, NJ 07071; T: (800) 933-7452; F: (201) 933-6225.
3. Substitutions: See Section 01 2500 - Substitution Procedures AND Section 01 6000 - Product Requirements.
a. See article in PART 1 above entitled "Available Manufacturers".

E. Primer: As recommended by manufacturer.

2.2 APPLICATIONS

A. At all wall penetrations located at outside surfaces of back-up walls and other locations indicated on the drawings.
B. Substitutions: See Section 01 2500 - Substitution Procedures AND Section 01 6000 - Product Requirements.
1. See article in PART 1 above entitled "Available Manufacturers".

2.3 SEALANTS

A. Silyl-terminated Polyether Sealant: Type GPX as specified in Section 07 90 05.
B. Primers, Cleaners, and Other Sealant Materials: As recommended by sealant manufacturer, appropriate to application, and compatible with adjacent materials.

2.4 ACCESSORIES

A. Primers as recommended by membrane flashing manufacturer.
B. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.2 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.
B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
C. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

D. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
E. Self-Adhesive Sheets:
   1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
   2. Lap sheets shingle-fashion to shed water and seal laps air tight.
   3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that all laps are firmly adhered with no gaps or fishmouths.
   4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.
   5. At wide joints, provide extra flexible membrane allowing joint movement.
F. Openings and Penetrations in Exterior air Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto air barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
   2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches (100 mm) wide; do not seal sill flange.
   3. At openings to be filled with non-flanged frames, seal air barrier to all sides of opening framing, using flashing at least 9 inches (230 mm) wide, covering entire depth of framing.
   4. At head of openings, install flashing under air barrier extending at least 2 inches (50 mm) beyond face of jambs; seal air barrier to flashing.
   5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
   6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

3.4 FIELD QUALITY CONTROL

A. Do not cover installed air barriers until required inspections have been completed.
B. Obtain approval of installation procedures by the membrane flashing manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
C. Take digital photographs of each portion of the installation prior to covering up.

3.5 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

3.6 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.
B. Install air and vapor seal materials and assemblies in conjunction with materials described in other sections to provide continuous sealed barrier in the exterior enclosure of the building.
C. Self-Adhesive Sheet Seal: Install over entire surface, sealing laps airtight; seal to adjacent construction.
D. Exterior Masonry Veneer: Install masonry anchors before installing air/vapor retarder; seal around anchors airtight.

END OF SECTION

SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fluid-applied membrane air barrier located in the non-accessible part of the wall.
B. Materials to bridge and seal the following air leakage pathways and gaps:
   1. Openings and penetrations of window frames, storefront, curtain wall.
   2. Closing previous openings in walls.
   3. Door frames.
   4. Masonry ties, screws, bolts and similar penetrations.
   5. All other air leakage pathways in the building envelope.

1.2 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 09 21 16 - Gypsum Board Assemblies: Sheathing

1.3 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ABAA - Air Barrier Association of America - a national, not-for-profit trade association that consists of a wide cross section of stakeholders in the building enclosure industry. current evaluations.
B. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers 2017.
C. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.
D. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies 2018.
E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
F. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components 2019.

1.4 PERFORMANCE REQUIREMENTS

A. Material Performance: Provide air barrier materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm/ft2 @ 1.57 psf), [0.02 liters per square meter per second under a pressure differential of 75 Pa (0.02 L/(s·m2) @ 75 Pa)] when tested in accordance with ASTM E2178 (unmodified).
B. The water vapor permeance shall be at or between 6.1 US perms and 15.0 US perms as determined in accordance with ASTM E96/E96M water method - unmodified (aka Procedure B) and shall be declared by the material manufacturer. The rating shall be of the material in the dry state as it is to perform within the assembly.

1. For the purposes of the work of this contract the water vapor permeance shall be at or between 351 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential *(351 ng/(Pa·s·m2) [6.1 US perms]* and 857 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential *(857 ng/(Pa·s·m2) [15.0 US perms]* at tested thickness per manufacturer.

C. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft2 @ 1.57 psf) [0.2 liters per square meter per second under a pressure differential of 75 Pa (0.2 L/(s·m2) @ 75 Pa)] when tested in accordance with ASTM E2357 . The assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.
   1. The air barrier shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement and shall transfer the load to the structure.
   2. Fluid applied air barriers shall not displace adjacent materials in the air barrier assembly under full load.
   3. The air barrier assembly shall be joined in an airtight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.
      a. Connections to Adjacent Materials: Provide connections to prevent air leakage at the following locations:
         1) Foundation and walls, including penetrations, ties and anchors.
         2) Walls, windows, curtain walls, storefronts, louvers and doors.
         3) Different assemblies and fixed openings within those assemblies.
         4) Wall and roof connections.
         5) Floors over unconditioned space.
         6) Walls, floor and roof across construction, control and expansion joints.
         7) Walls, floors and roof to utility, pipe and duct penetrations.
         8) Seismic and expansion joints.
         9) All other potential air leakage pathways in the building envelope.

1.5 SUBMITTALS

A. Submittals: Submit in accordance with Division 1 requirements.

B. Quality Assurance Program: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA) Quality Assurance Program (QAP). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).

C. Product Data: Submit material Manufacturer's Product Data, material manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, Technical Data, and tested physical and performance properties.
   1. Submit letter from primary air barrier material manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that manufacturer's material.

2. Include statement from the primary air barrier material manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.

D. Samples: Submit clearly labeled samples, three (3) inch by four (4) inch [75 mm by 100 mm] minimum size of each material specified.

E. Submit certification of tested and approved assemblies.

F. Shop Drawings of Mock-Up: Submit Shop Drawings of proposed mock-ups showing plans, elevations, large-scale details, and air barrier transitions and terminations.

G. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.

H. Shop Drawings: Submit Shop Drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated, how materials that cover the materials are secured with air-tight condition maintained, and how miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed.
   1. Include VOC content of each material, and applicable legal limit in the jurisdiction of the project.
   2. Include statement that materials are compatible with adjacent materials proposed for use.
   3. Include required values for field adhesion test on each substrate in accordance with ASTM D4541 (modified), using a type II pull tester.
   4. Compatibility: Submit letter from primary material manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

I. Air Barrier Subcontractor Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA) whose Installer(s) are certified in accordance with the site Quality Assurance Program used by ABAA.
   1. Fluid-applied membrane air barrier Installer(s) shall be certified by BPQI (Building Performance Quality Institute) for the ABAA Quality Assurance Program in accordance with the requirements outlined in the QAP program used by ABAA. Installers shall have their photo identification air barrier certification cards in their possession and available on the project site, for inspection upon request.
   2. Manufacturer: Obtain primary ABAA Evaluated Materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified fluid-applied membranes. Obtain secondary materials from a source acceptable to the primary materials Manufacturer.

J. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).

K. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.

L. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction and testing of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans. Attendance is required by representatives of related trades including covering materials, substrate materials and adjacent materials.

M. Field Quality Assurance: Implement the site Quality Assurance Program requirements used by ABAA. Cooperate with ABAA auditors and any independent testing and inspection agencies engaged by the Owner. Do not cover the air barrier assembly until it has been inspected, tested and accepted.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.

C. Handle materials in accordance with material manufacturer’s recommendations.

1.7 PROJECT CONDITIONS

A. Temperature: Install fluid-applied air barrier material within range of ambient and substrate temperatures recommended by material manufacturer. Do not apply air barrier to a damp or wet substrate.

B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.

C. Sequencing. Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.

D. Compatibility. Do not allow air barrier materials to come in contact with chemically incompatible materials.

E. Ultra-violet exposure. Do not expose air barrier materials to sunlight longer than as recommended by the material manufacturer.

1.8 WARRANTY

A. Material Warranty: Provide material manufacturer’s standard product warranty, for a minimum three (3) years from date of Substantial Completion.

B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a two (2) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

PART 2 - MATERIALS

2.1 AIR BARRIER MATERIALS

A. Fluid-Applied Membrane Air Barrier: Use regular, high temperature or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Subject to compliance with requirements, provide one of the following:

1. Material: Fire-Resist Barritech VP @ 60 mils thick (wet) by Carlisle Coatings and Waterproofing www.carlisle-ccw.com:
   a. Air Barrier Material Properties:
      1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft2 @ 1.57 psf), [0.001 liters per square meter per second under a pressure differential of 75 Pa (0.001 L/(s·m2) @ 75 Pa)] at 65 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 41.1 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (41.1 ng/(Pa·s·m2) [0.719 US perms] at 60 mils (wet) [40 mils (dry)] when tested in accordance with ASTM E96/E96M (desiccant method - unmodified).
      3) Water vapor permeance for this material has been tested and reported as being 817 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (817 ng/(Pa·s·m2) [**14.295** US perms] at 60 mils (wet) [40 mils (dry)] when tested in accordance with ASTM E96/E96M (water method – unmodified).
   b. Air Barrier Accessory Materials:
      1) Detail Flashing: Fire-Resist 705 FR
      2) Through-Wall Flashings or Shelf Angle Flashings: Stainless Steel (SS) Flashing Drainage System: Flash-Vent SS by York Manufacturing, Inc., www.yorkmfg.com/#sle.
      3) Counter-flashing for Metal Wall Flashings: Fire-Resist 705 FR.
      4) Water-Based Primer for Detail Flashing: CCW-702 WB
      5) Solvent-based products are not allowed UNLESS VERIFIED TO PASS NFPA 285 IN AN ABAA APPROVED ASSEMBLY AND ALLOWED BY CODE.
      6) Reinforcing Fabric: DCH Reinforcing Fabric
      7) Glass Mat: LiquiFiber-W
      8) Termination Mastic: SURE-SEAL Lap Sealant
      9) Fill Compound: CCW-201 or CCW-703 V
2. Material: Perm-A-Barrier VP, 90 mils thick (wet), 45 mils thick (dry) by Grace Construction Products www.na.graceconstruction.com:
   a. Air Barrier Material Properties:
      1) Air permeance for this material has been tested and reported as being 0.0004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0004 cfm/ft2 @ 1.57 psf), [0.002 liters per square meter per second under a pressure differential of 75 Pa (0.002 L/(s·m2) @ 75 Pa)] at 69 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 34.39 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (34.39 ng/(Pa·s·m2) [0.60

US perms] at 40 mils (dry) when tested in accordance with ASTM E96/E96M (desiccant method - unmodified).

3) Water vapor permeance for this material has been tested and reported as being 741.6 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (741.6 ng/(Pa·s·m2) [**12.9** US perms] at 40 mils (dry) when tested in accordance with ASTM E96/E96M (water method – unmodified).

b. Air Barrier Accessory Materials:

1) Membrane for details and Terminations: Bituthene Liquid Membrane.
2) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer or Perm-A-Barrier Primer Plus.
3) Solvent-based Primers are not allowed UNLESS VERIFIED TO PASS NFPA 285 IN AN ABAA APPROVED ASSEMBLY AND ALLOWED BY CODE.
4) Through-Wall Flashings or Shelf Angle Flashings: Stainless Steel (SS) Flashing Drainage System: Flash-Vent SS by York Manufacturing, Inc., www.yorkmfg.com/#sle
5) Sealants, Mastics, Adhesives and Tapes: As recommended by Grace Construction Products.
6) Transition Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
7) Penetrations & Termination Sealant: Bituthene Liquid Membrane and as recommended by Grace Construction Products.
8) Window Flashing and Detail Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
9) Joint Sealant: Refer to Technical Letter 1 for details on compatible waterproofing sealants.

3. Material: Air Bloc 33 MR by Henry at 100 mils (wet), 59 mils thick (dry) www.henry.com:

a. Air Barrier Material Properties:

1) Air permeance for this material has been tested and reported as being 0.0016 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0016 cfm/ft2 @ 1.57 psf), [0.0008 liters per square meter per second under a pressure differential of 75 Pa (0.0008 L/(s·m2) @ 75 Pa)] when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 19.0 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (19.0 ng/(Pa·s·m2) [0.34 US perms] at 59 mils (dry) when tested in accordance with ASTM E96/E96M (desiccant method – unmodified).
3) Water vapor permeance for this material has been tested and reported as being 652 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (652 ng/(Pa·s·m2) [**11.4** US perms] at 59 mils (dry) when tested in accordance with ASTM E96/E96M (water method – unmodified).

b. Air Barrier Accessory Materials:

1) Transition Membrane: Blueskin SA and Blueskin SALT for low-temperature applications.
2) Water-Based Primer for Transition Membrane: Aquatec Primer.
3) Solvent-based Primers are not allowed UNLESS VERIFIED TO PASS NFPA 285 IN AN ABAA APPROVED ASSEMBLY AND ALLOWED BY CODE.

4) Through-Wall Flashings or Shelf Angle Flashings: Stainless Steel (SS) Flashing Drainage System: Flash-Vent SS by York Manufacturing, Inc., www.yorkmfg.com/#sle
5) Counter-flashing for Masonry Through-Wall Flashing: Blueskin TWF.
6) Sealant: HE 925 BES Sealant
7) Reinforcing Tape: HE 183 Yellow Glass Fabric
8) Mastics, Adhesives and Tapes: Henry 570-05 Polybitume.

4. Material: GE Elemax 2600 by Momentive Performance Materials at 17 mils (dry) www.ge.com/silicones:
   a. Air Barrier Material Properties:
      1) Air permeance for this material has been tested and reported as being 0.0006 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0006 cfm/ft2 @ 1.57 psf), [0.003 liters per square meter per second under a pressure differential of 75 Pa (0.003 L/(s·m2) @ 75 Pa)] at 17 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 453 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (453 ng/(Pa·s·m2) [7.92 US perms] at 17 mils (dry) when tested in accordance with ASTM E96/E96M (desiccant method – unmodified).
      3) Water vapor permeance for this material has been tested and reported as being 581 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (581 ng/(Pa·s·m2) [**10.16** US perms] at 17 mils (dry) when tested in accordance with ASTM E96/E96M (water method – unmodified).
   b. Air Barrier Accessory Materials:
      1) Solvent-Based Primer: SS80 --- VERIFY IF PASSES NFPA 285 IN AN ABAA APPROVED ASSEMBLY AND ALLOWED BY CODE.
      2) Sealants: Elemax 5000 Liquid Flashing, SilPruf SCS2000, SilPruf SCS9000, SilPruf SCS2700, SWS
      3) Transition Membrane for details and terminations: Elemax 5000 Liquid Flashing, UltraSpan UST2200, UltraSpan USM pre-formed silicone molded corners parts
      4) Substrate Joint Treatment: Elemax 5000 Liquid Flashing, SilPruf SCS2000, SilPruf SCS9000, SilPruf SCS2700, SWS
      5) Reinforcing Fabric: RF100
5. Material: Pecora XL-Perm ULTRA VP by Pecora USA at 9 – 12 mils (dry). www.pecora.com:
   a. Air Barrier Material Properties:
      1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft2 @ 1.57 psf), 0.0012 liters per square meter per second under a pressure differential of 75 Pa (0.0012 L/(s·m2) @ 75 Pa)] at 12 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 653.22 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential 653.22 ng/(Pa·s·m2) [0.11.42 US perms] at 9 mils - dry when tested in accordance with ASTM E96/E96M (desiccant method - unmodified).
   b. Air Barrier Accessory Materials:

1) Sealants: 890NST Silicone Sealant, AVB Silicone Sealant
2) Transition Membrane for details and terminations: XL Span
3) Flashing at Transition Membranes: XL Flash Liquid Flashing & Joint Filler
4) Through-Wall Flashings or Shelf Angle Flashings: Stainless Steel (SS) Flashing Drainage System: Flash-Vent SS by York Manufacturing, Inc., www.yorkmfg.com/#sle
5) Counter-Flashing for Masonry Through-Wall Flashings: XL Flash Liquid Flashing & Joint Filler
6) Substrate Joint Treatment: XL Flash Liquid Flashing & Joint Filler, 890 NST Silicone Sealant, AC-20 Latex Sealant, AVW-920 Latex Sealant, Dynatrol I-XL-345 Tru White STPU Sealant

6. Material: Protecto Wall Liquid Air Barrier VP by Protecto Wrap at 10 mils (dry) www.protectowrap.com
   a. Air Barrier Material Properties:
      1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000864 cfm/ft2 @ 1.57 psf), 0.0043 liters per square meter per second under a pressure differential of 75 Pa (0.0043 L/(s·m2) @ 75 Pa)] at 10 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 55.3 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (55.3 ng/(Pa·s·m2) [0.96 US perms] at 22 mils (dry) when tested in accordance with ASTM E96/E96M (desiccant method - unmodified).
      3) Water vapor permeance for this material has been tested and reported as being 660.8 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (660.8 ng/(Pa·s·m2) [**11.5** US perms] at 22 mils (dry) when tested in accordance with ASTM E96/E96M (water method – unmodified).
   b. Air Barrier Accessory Materials:
      1) Water-Based Primer: Universal Water Based Primer
      2) Solvent-based products not allowed UNLESS VERIFIED TO PASS NFPA 285 IN AN ABAA APPROVED ASSEMBLY AND ALLOWED BY CODE.
      3) Sealants: Protecto Wall Board to Board Joint Sealant
      4) Transition Membrane for details and terminations: Protecto Wall Transition Tape
      5) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Universal Water Based Primer
      6) Substrate Joint Treatment: Protecto Wall Board to Board Joint Sealant
7. Material: Sikagard 535 Liquid Applied Vapor Permeable Air Barrier by Sika Corporation at 20 mils (dry) www.sika.com:
   a. Air Barrier Material Properties:
      1) Air permeance for this material has been tested and reported as being 0.00018 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (< 0.00018 cfm/ft2 @ 1.57 psf), 0.0009 liters per square meter per second under a pressure differential of 75 Pa (0.0009 L/(s·m2) @ 75 Pa)] at 10 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 108 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (108 ng/(Pa·s·m2) [1.9 US

perms] at 20 mils (dry) when tested in accordance with ASTM E96/E96M (desiccant method - unmodified).

3) Water vapor permeance for this material has been tested and reported as being 351 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (351 ng/(Pa·s·m2) [**6.1** US perms] at 20 mils (dry) when tested in accordance with ASTM E96/E96M (water method – unmodified).

b. Air Barrier Accessory Materials:

1) Self-Adhering Membrane Seam Tape: SikaMultiSeal® or SikaMembran® 540
2) Liquid Seam Sealant: Sikaflex® 11FC
3) Penetration Sealant: Sikaflex® 11FC
4) Primer: Sikagard 510 for self-adhering transition and flashing membrane
5) Surface Conditioner: Sikagard 530 or 535 Liquid Air Barrier Membrane
6) Self-Adhering Thru-Wall Flashing: Sika® MultiSeal

8. Material: Emerald Coat by Sto Corp at 20 mils (dry) www.stocorp.com

a. Air Barrier Material Properties:

1) Air permeance for this material has been tested and reported as being 0.000024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft2 @ 1.57 psf), [0.00020 liters per square meter per second under a pressure differential of 75 Pa (0.00020 L/(s·m2) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 121.26 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (121.26 ng/(Pa·s·m2) [2.12 US perms] at 12 mils (dry) when tested in accordance with ASTM E96/E96M (desiccant method - unmodified).
3) Water vapor permeance for this material has been tested and reported as being 797.94 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (797.94 ng/(Pa·s·m2) [**13.95** US perms] at 12 mils (dry) when tested in accordance with ASTM E96/E96M (water method – unmodified).

b. Air Barrier Accessory Materials:

1) Joint and Rough Opening Treatments: Sto Gold Fill with StoGuard Mesh, StoGuard Rapid Seal with StoGuard Mesh, Sto EmeraldCoat with StoGuard Fabric, StoGuard Tape
2) Joint Reinforcements: StoGuard Mesh, StoGuard Fabric, StoGuard RediCorner
3) Transition Membranes: Sto Gold Fill with StoGuard Mesh, StoGuard RapidSeal or StoGuard RapidSeal with StoGuard Mesh, Sto Emerald Cost with StoGuard Fabric, StoGuard Tape
4) Water-Based Primer for use with Flashing Transition: StoGuard Primer

9. Material: Wall Guardian FW-100-A (Acrylic-based component) by KEMPER, STS Coatings 40 mils (wet), 20 mils (dry) www.wallguardian.com:

a. Air Barrier Material Properties:

1) Air permeance for this material has been tested and reported as being 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft2 @ 1.57 psf), 0.0005 liters per square meter per second under a pressure differential of 75 Pa (0.0005 L/(s·m2) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).

2) Water vapor permeance for this material has been tested and reported as being 55.3 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (55.3 ng/(Pa·s·m2) [0.96 US perms] at 22 mils (dry) when tested in accordance with ASTM E96/E96M (desiccant method - unmodified).
3) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m2) [**11.5** US perms] at 22 mils (dry) when tested in accordance with ASTM E96/E96M (water method – unmodified).
4) Passed ASTM E331 (modified), 2hr @ ΔP=6.24psf and ΔP=10psf at 3.4 L/m2·min water spray; 15min @ ΔP=15psf at 3.4 L/m2·min water spray.

b. Air Barrier Accessory Materials:
1) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: none
2) Solvent-based products not allowed UNLESS VERIFIED TO PASS NFPA 285 IN AN APPROVED ASSEMBLY AND ALLOWED BY CODE.
3) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BP-40 Primer for use with UT-40 Universal Tape. MUST BE VERIFIED TO PASS NFPA 285 IN AN ABAA APPROVED ASSEMBLY AND ALLOWED BY CODE.
4) Through-Wall Flashings or Shelf Angle Flashings: Stainless Steel (SS) Flashing Drainage System: Flash-Vent SS by York Manufacturing, Inc., www.yorkmfg.com/#sle
5) Mastics: none
6) Adhesives and Tapes: Universal Tape UT-40, a butyl based tape and Great Seal LT-100, a low VOC elastomeric sealant for deflection joints and details
7) Transition Strip: Universal Tape, UT-40
8) Termination Mastic: Great Seal LT-100
9) Window Flashing and Detail Membrane: Universal Tape UT-40

10. Material: TK-AirMax 2103 by TK Products at 40+ mils (wet). www.tkproducts.com:
a. Air Barrier Material Properties:
1) Air permeance for this material has been tested and reported as being 0.00097 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00097 cfm/ft2 @ 1.57 psf), 0.00492 liters per square meter per second under a pressure differential of 75 Pa (0.00492 L/(s·m2) @ 75 Pa)] at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 6.669 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (6.669 ng/(Pa·s·m2) [0.117 US perms] at 19 mils (dry) when tested in accordance with ASTM E96/E96M (desiccant method - unmodified).
3) Water vapor permeance for this material has been tested and reported as being 857 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (857 ng/(Pa·s·m2) [**15.0** US perms] at 20 mils (dry) when tested in accordance with ASTM E96/E96M (water method – unmodified).

b. Air Barrier Accessory Materials:
1) Wherever solvent-based products are used, verify the tested and approved system passes NFPA 285 and is allowed by code. Submit certified testing data.

2) Through-Wall Flashings or Shelf Angle Flashings: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
3) Caulk: TK-Super Seal
4) Adhesives and Tapes: TK-AirMax 2200 All Weather Flashing (TK Products), TK Air Max 2203 Caulk, TK-AirMax 2201 Red Sheathing Facing Tape (Venture Tape, a 3M Company), 3M All-Weather Flashing Tape 8067 (3M Company), VentureStop VB 400 (Venture Tape, a 3M Company), Venture-1585 CW-2 Red Sheathing Facing Tape (Venture Tape, a 3M Company)
5) Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
6) Reinforcing/Joint Tape: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
7) Termination of Caulk: TK-AirMax Caulk 2203 (TK Products), Manus-Bond 75AM (Manus Products, Inc.)
8) Through-Wall Flashings or Shelf Angle Flashings: Stainless Steel (SS) Flashing Drainage System: Flash-Vent SS by York Manufacturing, Inc., www.yorkmfg.com/#sle

B. Material: Air-Shield LMP, W. R. Meadows, Inc. at 90 mils (wet), 45 mils (dry) www.wrmeadows.com:
1. Air Barrier Material Properties:
   a. Air permeance for this material has been tested and reported as being 0.000096 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000096 cfm/ft2 @ 1.57 psf), [0.00048 liters per square meter per second under a pressure differential of 75 Pa (0.00048 L/(s·m2) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
   b. Water vapor permeance for this material has been tested and reported as being 9.62 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (9.62 ng/(Pa·s·m2) [0.168 US perms] at 47.6 mils (dry) when tested in accordance with ASTM E96/E96M (desiccant method – unmodified).
   c. Water vapor permeance for this material has been tested and reported as being 598 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (598 ng/(Pa·s·m2) [**10.47** US perms] at 47.6 mils (dry) when tested in accordance with ASTM E96/E96M (water method – unmodified).
2. Air Barrier Accessory Materials:
   a. Water-Based Primer: none required for Air Shield LMP
   b. Solvent-based products not allowed UNLESS VERIFIED TO PASS NFPA 285 IN AN ABAA APPROVED ASSEMBLY AND ALLOWED BY CODE.
   c. Termination Mastic: Pointing Mastic or BEM
   d. Transition Membrane for details and terminations: Air Shield
   e. Reinforcing/Joint Tape: Reinforcing Fabric HCR
   f. Flashing at Transition Membrane: Air Shield Thru-Wall Flashing
   g. Counter-flashing for Masonry Through-Wall Flashings: Air Shield Thru-Wall Flashing
   h. Through-Wall Flashings or Shelf Angle Flashings: Stainless Steel (SS) Flashing Drainage System: Flash-Vent SS by York Manufacturing, Inc.,

www.yorkmfg.com/#sle

i. Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime WB

j. Substrate Joint Treatment: Air Shield Joint Filler

PART 3 - EXECUTION

3.1 EXAMINATION

A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with ABAA Certified Installer present, for compliance with requirements.

1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
2. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
3. Ensure that the following conditions are met:
   a. Surfaces are sound, dry, even, and free of excess mortar or other contaminants.
   b. Inspect substrates to be smooth without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the concrete sub-trade.
   c. Inspect masonry joints to be reasonably flush and completely filled, and ensure all excess mortar sitting on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the mason sub-trade.
      1) Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263 and take suitable measures until substrate passes moisture test.
      2) Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
      3) Notify Architect in writing of anticipated problems using fluid-applied membrane over substrate prior to proceeding.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to material Manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

1. Ensure that penetrating work by other trades is in place and complete.
2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the fluid-applied membrane.
3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges or with a material chemically compatible with the primary air material.

B. Prime substrate for installation of sheet membrane transition strips if recommended by material manufacturer and as follows:

1. Prime masonry, concrete substrates with conditioning primers.
2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
3. Prime wood, metal, and painted substrates with primer.

4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier at protrusions.

C. Prime substrate for installation of fluid-applied air barrier if recommended by material manufacturer based on project conditions.

D. Protection from spray-applied materials:
   1. Mask and cover adjacent areas to protect from over-spray.
   2. Ensure any required foam stop or back up materials are in place to prevent over-spray and achieve complete seal.

3.3 INSTALLATION

A. Fluid Applied Membrane Air Barrier: Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material manufacturer's instructions and the following (unless manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):
   1. Install veneer anchors as per air barrier manufacturer installation sequencing.
   2. Apply treatment to exterior gypsum joints and screw heads as per air barrier material manufacturer.
   3. Apply primer for transition material at the rate instructed by the air barrier material manufacturer for 1 inch (25mm) beyond terminating edge of transition membrane. Allow primer to set/cure completely before transition strip application.
   4. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches (50 mm), unless greater overlap is recommended by the material manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.
   5. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches (50 mm), unless greater overlap is recommended by the material manufacturer. Roll all areas of transition strip including seams with roller.
   6. Seal around all penetrations with termination mastic/sealant, membrane counter-flashing or other procedure in accordance with material manufacturer’s instructions, ensuring chemical compatibility amongst adjoining materials.
   7. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material manufacturer’s instructions.
   8. Provide transition material at changes in substrate plane (with bead of sealant/mastic, membrane counter-flashing or other material recommended by material manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
   9. Provide mechanically fastened non-corrosive metal sheet or other manufacturer approved transition material to span gaps greater than 1 inch (25 mm) in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch (50 mm) overlap

on both edges.

10. For through-wall flashing and head-flashing, lap transition material over top edge of it.
11. Provide backup for the membrane to accommodate anticipated movement or use other manufacturer approved transition material at deflection and control joints.
12. Provide transition to the joint assemblies at expansion and seismic joints.
13. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the material manufacturer.
14. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.
15. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material manufacturer.
16. Install primer for fluid-applied air barrier if instructed by material manufacturer.
17. Install fluid-applied membrane using equipment and methods recommended by manufacturer, to achieve a dry film thickness as required by the material manufacturer.

3.4 FIELD QUALITY CONTROL

A. Owner's Inspection and Testing: Cooperate with Owner's testing agency. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.

B. Air Barrier Association of America Installer Audits: Cooperate with ABAA's testing agency. Allow access to work areas and staging. Notify ABAA in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted. Arrange and pay for site audits by ABAA to verify conformance with the material manufacturer's instructions, the site Quality Assurance Program used by ABAA, and this section of the project specification.
   1. Audits and subsequent testing shall be carried out at the following rate:
      a. Up to 10,000 ft2 of air barrier contract requires one (1) audit.
      b. 10,001 – 35,000 ft2 of air barrier contract requires two (2) audits.
      c. 35,001 – 75,000 ft2 of air barrier contract requires three (3) audits.
      d. 75,001 - 125,000 ft2 of air barrier contract requires four (4) audits.
      e. 125,001 – 200,000 ft2 of air barrier contract requires five (5) audits.
      f. 200,001 ft2 and over of air barrier contract requires six (6) audits.

C. Forward written audit reports to the Architect within 10 working days of the inspection and test being performed.

D. If the inspections reveal any defects, promptly remove and replace defective work at no additional cost to the Owner.

3.5 PROTECTING AND CLEANING

A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material manufacturer's written instructions.
   1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier manufacturer.

2. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the primary material manufacturer.

END OF SECTION

SECTION 07 41 13

METAL ROOF PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural roofing system, Types **RS-1** and **RS-2** of preformed steel panels.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 07 42 13 - Metal Wall Panels: Preformed wall panels.
C. Section 07 92 00 - Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.
D. Section 13 34 19 - Metal Building Systems.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process 2021a.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
D. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference 2005 (Reapproved 2017).
E. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference 2011 (Reapproved 2018).

F. ASTM E1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems 2016.
G. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems 2018.
H. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies Current Edition, Including All Revisions.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Storage and handling requirements and recommendations.
   2. Installation methods.
   3. Specimen warranty.
C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
   1. Show work to be field-fabricated or field-assembled.
   2. Include structural analysis signed and sealed by qualified structural engineer, indicating compliance of roofing system to specified loading conditions.
D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.
E. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches (305 mm) square, representing actual roofing metal, thickness, profile, color, and texture.
   1. Include typical panel joint in sample.
   2. Include typical fastening detail.
F. Manufacturer Qualification Statement: Provide documentation showing metal roof panel fabricator is accredited under IAS AC472.
G. Buy American Certification: Upon delivery of product, provide notarized original of TxDOT Form 1818 (aka Form D-9-USA-1) with the proper attachments for verification of compliance.
H. Test Reports: Indicate compliance of metal roofing system to specified requirements.
I. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Buy America: Manufacturer shall provide products complying with the latest provisions of Buy America as listed at 23 CFR 635.410. For steel and iron materials, all manufacturing processes, including application of a coating, must occur in the United States.
B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.
B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.8 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.
B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of five years from Date of Substantial Completion.
C. Waterproofing Warranty: Provide manufacturer's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within specified warranty period of five years from Date of Substantial Completion.

1.9 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design:
    1. Metal Roof Panels at Maintenance Building, Type **RS-1**: LokSeam manufactured by MBCI: www.mbci.com.
    2. Metal Roof Panels at Pre-Engineered Metal Building, Type **RS-2**: PBR (R Panel) manufactured by MBCI: www.mbci.com.
B. Other Acceptable Manufacturers; Metal Roof Panels:
    1. ATAS International, Inc: www.atas.com/#sle.
    2. Berridge Manufacturing Company: www.berridge.com/#sle.
    3. McElroy Metal: www.mcelroy.com
C. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
    1. See article in PART 1 above entitled "Available Manufacturers".

2.2 STRUCTURAL METAL ROOF PANELS

A. Structural Metal Roofing: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following

minimum standards:

1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
   a. Dead Loads: Weight of roofing system.
   b. Live Loads: As required by ASCE 7.
2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
3. Wind Uplift: Class 90 wind uplift resistance of UL 580.
4. Air Infiltration: Maximum 0.06 cfm/sq ft (1.1 cubic meters/hr/sq m) at air pressure differential of 6.24 lbf/sq ft (300 Pa), when tested according to ASTM E1680.
5. Water Penetration: No water penetration when tested according to procedures and recommended test pressures of ASTM E1646. Perform test immediately following air infiltration test.
6. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F (56 degrees C).

B. Metal Panels: Factory-formed panels with factory-applied finish.
   1. Type: Single skin, uninsulated.
   2. Steel Panels:
      a. Aluminum-zinc alloy-coated SS (structural steel) sheet complying with ASTM A792/A792M; minimum AZ50 (AZM150) coating.
      b. Steel Thickness: Minimum 24 gage (0.024 inch) (0.61 mm).
   3. Profile: Standing seam, with minimum 1.0 inch (25 mm) seam height; concealed fastener system for field seaming with special tool.
   4. Texture: Smooth.
   5. Length: Maximum possible length to minimize lapped joints.
   6. Width: Maximum panel coverage of 16 inches (406 mm).

2.3 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.4 FABRICATION

A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.5 FINISHES

A. Clear Acrylic Coating: Manufacturer's clear organic resin surface treatment applied to both surfaces of the sheet.

B. Solar Reflectance Index (SRI): 82, Initial, <2:12 Low-sloped roof.

2.6 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:

1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

D. Thermal Insulation: Provide flexible blanket type, faced with white, flexible, non-dusting vapor retarder tested for maximum flame spread index of 50, per ASTM E84; for installation using spacer blocks.

1. Thickness: As indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to assure that the completed roof will be free of leaks.

B. Remove protective film from surface of roof panels immediately prior to installation. Strip film carefully, to avoid damage to prefinished surfaces.

C. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by roof panel manufacturer.

D. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.

1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
2. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.

B. Accessories: Install all components required for a complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.
C. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.
    1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by the panel manufacturer.

3.4 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.5 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.
B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 07 42 13

METAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured metal panels, Types **MP-1**, **-2**, **-3**, and **SFT-1** for exterior wall panels, soffit panels, and subgirt framing assembly, with related flashings and accessory components.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 05 40 00 - Cold-Formed Metal Framing: Wall panel substrate.
C. Section 07 21 00 - Thermal Insulation.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
B. 23 CFR 635.410 - Buy America requirements 2011.
C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process 2021a.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate dimensions, layout, joints, construction details, and methods of anchorage.

C. Samples: Submit two samples of wall panel and soffit panel, 12 inches by 12 inches (305 mm by 305 mm) in size illustrating finish color, sheen, and texture.
D. Manufacturer's Qualification Statement.
E. Installer's Qualification Statement.
F. Buy American Certification: Upon delivery of product, provide notarized original of TxDOT Form 1818 (aka Form D-9-USA-1) with the proper attachments for verification of compliance.

1.6 QUALITY ASSURANCE

A. Buy America: Manufacturer shall provide products complying with the latest provisions of Buy America as listed at 23 CFR 635.410. For steel and iron materials, all manufacturing processes, including application of a coating, must occur in the United States.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
C. Installer Qualifications: Company specializing in installing products of the type specified in this section with minimum three years of documented experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
C. Prevent contact with materials that may cause discoloration or staining of products.

1.8 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.
B. Correct defective work within a five year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
C. Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals for metal wall panels.

1.9 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 BASIS OF DESIGN MANUFACTURERS

A. Metal Wall Panels at Pre-Engineered Metal Building - Exposed Fasteners, Types **MP-2** and **MP-3**:
   1. MBCI; PBR (R Panel): www.mbci.com.
   2. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

B. Metal Wall Panels at Maintenance Building - Concealed Fasteners, Type **MP-1**:
   1. MBCI; Designer Series - Fluted: www.mbci.com.
   2. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

C. Metal Soffit Panels, Type **SFT-1**:
   1. MBCI; Artisan: www.mbci.com.
   2. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

2.2 MANUFACTURED METAL PANELS

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
   1. Provide exterior wall panels, interior liner panels, and subgirt framing assembly.
   2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
   3. Design Pressure: In accordance with applicable codes.
   4. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
   5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
   6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
   8. Corners: Factory-fabricated in one continuous piece with minimum 2 inch (51 mm) returns.

B. Exterior Wall Panels at Pre-Engineered Metal Building:
   1. Profile: Vertical; style as indicated.
   2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
   3. Material: Precoated steel sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.
   4. Panel Width: 36 inches (914 mm).
   5. Color: As indicated on drawings.

C. Exterior Wall Panels at Maintenance Building:
   1. Profile: Vertical; style as indicated.

2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
3. Material: Precoated steel sheet, 22 gauge, 0.0299 inch (0.76 mm) minimum thickness.
4. Panel Width: 16 inches (406 mm).
5. Color: As indicated on drawings.

D. Soffit Panels:
1. Profile: Style as indicated, with venting provided.
2. Material: Precoated steel sheet, 24 gage, 0.0276 inch (0.70 mm) minimum thickness.
3. Panel Width: 12 inches (305 mm).
4. Color: As indicated on drawings.

E. Subgirt Framing Assembly:
1. 16 gauge, 0.0598 inch (1.52 mm) thick formed non-precoated steel sheet.
2. Profile as indicated; to attach panel system to building.

F. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

G. Expansion Joints: Same material, thickness and finish as exterior sheets; 22 gage, 0.0299 inch (0.76 mm) thick; manufacturer's standard brake formed type, of profile to suit system.

H. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

I. Anchors: Galvanized steel.

2.3 MATERIALS

A. Precoated Steel Sheet: Aluminum-zinc alloy-coated steel sheet, ASTM A792/A792M, Commercial Steel (CS)) or Forming Steel (FS), with AZ50/AZM150 coating; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

B. Select materials with surface flatness, smoothness, and lack of surface blemishes where exposed to view in finished system.

C. Insulation: Glass fiber type specified in Section 07 21 00.

2.4 FINISHES

A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.

B. Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.

C. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat aluminum coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss to match sample.

D. Clear Acrylic Coating (at "Galvalume" type finishes): Manufacturer's clear organic resin surface treatment applied to both surfaces of the sheet.

2.5 ACCESSORIES

A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.

B. Concealed Sealants: Non-curing butyl sealant or tape sealant.

C. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.

D. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.
E. Field Touch-up Paint: As recommended by panel manufacturer.
F. Bituminous Paint: Asphalt base.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that building framing members are ready to receive panels.

3.2 PREPARATION

A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

3.3 INSTALLATION

A. Install panels on walls and soffits in accordance with manufacturer's instructions.
B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
C. Fasten panels to structural supports; aligned, level, and plumb.
D. Locate joints over supports.
E. Lap panel ends minimum 2 inches (51 mm).
F. Provide expansion joints where indicated.
G. Use concealed fasteners unless otherwise approved by Architect.
H. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.4 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch (1.6 mm).
B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch (6.4 mm).

3.5 CLEANING

A. Remove site cuttings from finish surfaces.
B. Remove protective material from wall panel surfaces.
C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 07 42 33

PLASTIC WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. PVC interlocking liner panels and trim.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 11 13 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM D3679 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding 2017.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
C. Samples: Provide samples in colors specified, not less than 12 inches (305 mm) in length.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Not less than three years of experience with products specified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 BASIS OF DESIGN MANUFACTURERS

A. PVC Liner Panels:
    1. Duralight Plastics; Trusscore: www.duralightplastics.com.
    2. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS

A. General Requirements:
    1. Siding: Complying with ASTM D3679.
    2. Surface Burning Characteristics: Flame spread index of 10, maximum; smoke developed index of 400, maximum; when tested in accordance with ASTM E84.
B. PVC Liner Panels:
    1. Total Thickness: 0.50 inch (13 mm), minimum, comprised of thick panel walls with an interior web design for rigidity.
    2. Panel Width: 16 inches (406 mm).
    3. Panel Length: 14 feet (4250 mm), minimum.
    4. Nailing Hem: Single layer on one side, with pre-punched fastener openings; interlocking with adjacent panel.
    5. Finish: Smooth.
    6. Color: As selected by Architect from manufacturers full range of available colors.

2.3 ACCESSORIES

A. Accessories: Provide coordinating accessories made of same material as required for complete and proper installation even when not specifically indicated on drawings.
    1. Color: Match adjacent siding and ceiling panels.

2. Length: 10 feet (3050 mm), minimum.
3. Trim Profiles: Provide types as indicated on drawings and as required for a finished installation .

B. Fasteners: Manufacturer recommended; length as required to penetrate solid backing at least 1 inch (25 mm).

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrate conditions before beginning installation; verify dimensions and acceptability of substrate.
B. Do not proceed with installation until unacceptable conditions have been corrected.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

A. Install siding and trim in accordance with manufacturer's printed installation instructions.
B. Attach securely to framing, not sheathing, with horizontal components true to level and vertical components true to plumb, providing a weather resistant installation.
C. Clean dirt from surface of installed products, using mild soap and water.

3.3 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.
B. Sealants for joints within sheet metal fabrications.
C. Precast concrete splash pads.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the related documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 04 43 13 - Stone Masonry Veneer.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).
B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).
D. CDA A4050 - Copper in Architecture - Handbook current edition.
E. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
C. Samples: Submit two samples 4 by 4 inch (100 by 100 mm) in size illustrating metal finish color.

D. Buy American Certification: Upon delivery of product, provide notarized original of TxDOT Form 1818 (aka Form D-9-USA-1) with the proper attachments for verification of compliance.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
B. Maintain one copy of each document on site.
C. Buy America: Manufacturer shall provide products complying with the latest provisions of Buy America as listed at 23 CFR 635.410. For steel and iron materials, all manufacturing processes, including application of a coating, must occur in the United States.
D. Fabricator and Installer Qualifications: Company specializing in sheet metal work with three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) (0.81 mm) thick; anodized finish of color as selected.
   1. Clear Anodized Finish: AAMA 611 AA-M12C22A41 Class I clear anodic coating not less than 0.7 mils (0.018 mm) thick.
B. Acrylic Coated Galvalume: ASTM A 792/A 792 M-97a, Standard Specification for Sheet Steel, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; A coating of 55% Al-Zn on steel sheet with a rolled, uniform, thin film of a water-base acrylic solution onto both surfaces of the sheet which is then heated to dry the film. 24 gage.
C. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gage, (0.0156 inch) (0.40 mm) thick; smooth No. 4 - Brushed finish.

2.2 THROUGH-WALL FLASHING

A. Through-Wall Flashing shall be Stainless Steel (SS) Flashing Drainage System (through wall flashing) - Engineered laminate composite of Stainless Steel, polymer fabric and non-woven drainage fabric. Use with stainless steel termination bar.
   1. Basis of Design: York Manufacturing, Inc.; York Flash-Vent SS: www.yorkmfg.com.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
B. Form pieces in longest possible lengths.
C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.
F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.4 GUTTER AND DOWNSPOUT FABRICATION

A. Gutters: SMACNA (ASMM) Rectangular profile.
B. Downspouts: Rectangular profile.
C. Gutters and Downspouts: Size indicated.
D. Accessories: Profiled to suit gutters and downspouts.
    1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
    2. Gutter Supports: Brackets.
    3. Downspout Supports: Brackets.
E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.
F. Seal metal joints.

2.5 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.
B. Primer: Zinc chromate type.
C. Concealed Sealants: Non-curing butyl sealant.
D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.1 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.
B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

3.2 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
B. Apply plastic cement compound between metal flashings and felt flashings.
C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
D. Secure gutters and downspouts in place with concealed fasteners.
E. Set splash pads under downspouts.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Firestopping systems.
B. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard substrate.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.
B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
C. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015 (Reapproved 2021)e1.
D. ITS (DIR) - Directory of Listed Products current edition.
E. FM (AG) - FM Approval Guide current edition.
F. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).
G. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.
H. UL (DIR) - Online Certifications Directory Current Edition.

I. UL (FRD) - Fire Resistance Directory Current Edition.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Installer Qualification: Submit qualification statements for installing mechanics.

1.6 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Trained by manufacturer.
   2. Verification of minimum three years documented experience installing work of this type.

1.7 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
B. Provide ventilation in areas where solvent-cured materials are being installed.

1.8 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Firestopping Manufacturers:

1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
2. Hilti, Inc: www.us.hilti.com/#sle.
3. Specified Technologies Inc: www.stifirestop.com/#sle.
4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
5. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
    a. See article in PART 1 above entitled "Available Manufacturers".

2.2 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.
B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
C. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
E. Fire Ratings: Refer to drawings for required systems and ratings.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
    1. Movement: Provide systems that have been tested to show movement capability as indicated.
B. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
    1. Movement: Provide systems that have been tested to show movement capability as indicated.
    2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
    1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.4 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
    1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.
    2. Fire Ratings: See drawings for required systems and ratings.
B. Firestopping at Uninsulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches (100 mm) or less: Caulk or putty.

C. Firestopping at Combustible Pipe and Conduit Penetrations, of diameter 4 inches (100 mm) or less: Caulk or putty.
D. Firestopping at Cable Tray Penetrations: Manufactured device.
E. Firestopping at Cable Penetrations, not in Conduit or Cable Tray: Caulk or putty.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
B. Remove incompatible materials that could adversely affect bond.
C. Install backing materials to prevent liquid material from leakage.

3.3 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
C. Install labeling required by code.

3.4 FIELD QUALITY CONTROL

A. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.5 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.
B. Self-leveling pourable joint sealants
C. Joint backings and accessories.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
C. Section 06 41 00 - Architectural Wood Casework, for color matched caulk.
D. Section 07 27 20 - Membrane Flashing.
E. Section 07 27 26 - Fluid-Applied Membrane Air Barrier.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015.
B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants 2018.
C. ASTM C834 - Standard Specification for Latex Sealants 2017.
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.
F. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.
H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.
I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Substrates for which laboratory adhesion and/or compatibility testing is required.
   7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   8. Sample product warranty.
C. Submit manufacturer’s product data and details showing:
   1. Joint Sealants: Layout of recommended minimum and maximum joint sealant width to depth relationships, and recommended primers for substrates and conditions indicated. Include material specifications showing compliance with requirements.
D. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
E. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
G. Installation Plan: Submit at least four weeks prior to start of installation.
H. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
I. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
J. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
K. Installation Log: Submit filled out log for each length or instance of sealant installed.
L. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
    1. Adhesion Testing: In accordance with ASTM C794.
    2. Compatibility Testing: In accordance with ASTM C1087.
    3. Allow sufficient time for testing to avoid delaying the work.
    4. Deliver to manufacturer sufficient samples for testing.
    5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
    6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
E. Installation Plan: Include schedule of sealed joints, including the following.
    1. Joint width indicated in Contract Documents.
    2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
    3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgement that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
    4. Installation Log Form: Include the following data fields, with known information filled out.
        a. Date of installation.
        b. Name of installer.
        c. Actual joint width; provide space to indicate maximum and minimum width.
        d. Actual joint depth to face of backing material at centerline of joint.
        e. Air temperature.
F. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
    1. Identification of testing agency.
    2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
        a. Test date.
        b. Sealant used.
        c. Test method used.
        d. Date of test.
        e. Copy of test method documents.
        f. Age of sealant upon date of testing.
        g. Test results, modeled after the sample form in the test method document.
        h. Indicate use of photographic record of test.
G. Field Quality Control Plan:
    1. Visual inspection of entire length of sealant joints.
    2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.

3. Field testing agency's qualifications.
4. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

H. Field Adhesion Test Procedures:
1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

I. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.

J. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inches (457 mm) long.
2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25.4 mm) by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

K. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.7 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

1.8 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect.

Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.

1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   1. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   2. Hilti, Inc: www.us.hilti.com/#sle.
   3. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
   4. Pecora Corporation: www.pecora.com.
   5. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   6. Sika Corporation: www.usa-sika.com/#sle.
   7. W.R. Meadows, Inc: www.wrmeadows.com.
   8. Substitutions: See Section 01 60 00 - Product Requirements.

B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
   1. Adhesives Technology Corporation: www.atcepoxy.com/#sle.
   2. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
   3. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   4. Pecora Corporation: www.pecora.com.
   5. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   6. Sika Corporation: www.usa-sika.com/#sle.
   7. W.R. Meadows, Inc: www.wrmeadows.com.
   8. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints indicated below.

2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    a. Joints between door, window, and other frames and adjacent construction.
    b. Other joints indicated below.
3. Do not seal the following types of joints.
    a. Intentional weepholes in masonry.
    b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
    c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    d. Joints where installation of sealant is specified in another section.
    e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use nonsag non-staining silicone sealant, Type SIL, unless otherwise indicated.
1. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.

D. Interior Wet Areas: Bathrooms, restrooms, kitchens, and food service areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.3 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 61 16.

2.4 NONSAG JOINT SEALANTS

A. Type SIL - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
5. Color: To be selected by Architect from manufacturer's standard range.
6. Cure Type: Neutral.
7. Service Temperature Range: Minus 20 to 180 degrees F (Minus 29 to 82 degrees C).
8. Manufacturers:
    a. Dow Chemical Company; DOWSIL 791 Silicone Weatherproofing Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
    b. Sika Corporation; Sikasil WS-295: www.usa-sika.com/#sle.

B. Type MRSIL - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.

1. Color: White.

C. Type PUI - Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface .
   1. Movement Capability: Plus and minus 35 percent, minimum.
   2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
   3. Color: To be selected by Architect from manufacturer's standard range.
   4. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).

D. Type ACREM - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
   1. Color: To be selected by Architect from manufacturer's standard range.
   2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).
   3. Manufacturers:
      a. Franklin International, Inc; Titebond GREENchoice Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
      b. Sherwin-Williams Company; Powerhouse Siliconized Acrylic Latex Sealant: www.sherwin-williams.com/#sle.

2.5 SELF-LEVELING SEALANTS

A. Type SLPU - Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
   3. Color: Gray.
   4. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).

2.6 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   2. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

D. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.
D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
   2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
   3. Record each test on Preinstallation Adhesion Test Log as indicated.
   4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
   5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.
B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Install bond breaker backing tape where backer rod cannot be used.
D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.4 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet (30 linear m), notify Architect immediately.
C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
C. Fire-rated hollow metal doors and frames.
D. Thermally insulated hollow metal doors with frames.
E. Accessories, including glazing.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 08 71 00 - Door Hardware.
C. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
D. Section 09 91 23 - Interior Painting: Field painting.

1.4 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.
B. NAAMM: National Association of Architectural Metal Manufacturers.
C. SDI: Steel Door Institute.
D. UL: Underwriters Laboratories.

1.5 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2011.
C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2003 (R2009).
D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2011.
F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021.
H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
J. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.
K. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
L. ITS (DIR) - Directory of Listed Products current edition.
M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.
N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.
O. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2007.
P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.
Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
R. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.
S. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2013.
T. TAS - 2012 Texas Accessibility Standards (TAS) 2012.
U. UL (DIR) - Online Certifications Directory Current Edition.
V. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.6 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for processing submittals.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
C. Maintain at project site copies of reference standards relating to installation of products specified.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

1.9 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Doors and Frames:
    1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
    2. Curries, an Assa Abloy Group company: www.assaabloydss.com.
    3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
    4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
    5. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
        a. See article in PART 1 above entitled "Available Manufacturers".

2.2 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

A. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Door Core Material: Polystyrene, 1 lbs/cu ft minimum density.
      a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
   3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
   4. Top Closures for Outswinging Doors: Flush with top of faces and edges.
   5. Door Face Sheets: Flush.
   6. Weatherstripping: Refer to Section 08 71 00.
   7. Door Finish: Factory primed and field finished.

B. Interior Doors, Non-Fire-Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.

2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
4. Door Face Sheets: Flush.
5. Door Finish: Factory primed and field finished.

C. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 3 - Extra Heavy-duty.
b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
b. Attach fire rating label to each fire rated unit.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
4. Door Face Sheets: Flush.
5. Door Finish: Factory primed and field finished.

2.4 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
B. Frame Finish: Factory primed and field finished.
C. Exterior Door Frames: Full profile/continuously welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
2. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
3. Weatherstripping: Separate, see Section 08 71 00.
D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
E. Door Frames, Fire-Rated: Full profile/continuously welded type.
1. Fire Rating: Same as door, labeled.
2. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.

2.5 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.6 ACCESSORIES

A. Door Window Frames: Door window frames with glazing securely fastened within door opening.
B. Window location above finished floor (AFF) shall comply with TAS and ADA Standards for accessibility requirements.
C. Glazing: As specified in Section 08 80 00, factory installed.

D. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered corners; prepared for countersink style tamper proof screws.
E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.
C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 PREPARATION

A. Vision glass fixed windows at doors. Important TAS & ADA Compliance Note
   1. Critical dimension for final in-place location of the bottom of the GLASS is a Maximum 3'-7" (43 inches (109.22 cm)) Above Finished Floor (AFF). Not from the bottom of the door and not to the frame of the window. The dimension is from Finished Floor to the bottom edge of the visible Glass. No exceptions.

3.3 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
B. Install fire rated units in accordance with NFPA 80.
C. Coordinate frame anchor placement with wall construction.
D. Install door hardware as specified in Section 08 71 00.
   1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
E. Comply with glazing installation requirements of Section 08 80 00.
F. Coordinate installation of electrical connections to electrical hardware items.

3.4 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.
C. Comply with TAS and ADA Standards for accessibility requirements.

3.5 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.6 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 08 11 13 - Hollow Metal Doors and Frames.
C. Section 08 71 00 - Door Hardware.
D. Section 08 80 00 - Glazing.
E. Section 09 91 23 - Interior Painting: Field finishing of doors.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights 2019c.
C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).
E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
F. TAS - 2012 Texas Accessibility Standards (TAS) 2012.
G. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

H. WDMA I.S. 1A - Interior Architectural Wood Flush Doors 2013.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
D. Samples: Submit two samples of door construction, 8 by 8 inches (200 by 200 mm) in size cut from top corner of door.
E. Samples: Submit two samples of door veneer, 8 by 8 inches (200 by 200 mm) in size illustrating wood grain, stain color, and sheen.
F. Manufacturer's Installation Instructions: Indicate special installation instructions.
G. Manufacturer's Qualification Statement.
H. Installer's Qualification Statement.
I. Specimen warranty.
J. Warranty, executed in Owner's name.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.
B. Accept doors on site in manufacturer's packaging, and inspect for damage.
C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.8 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.
B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Wood Veneer Faced Doors:
    1. Masonite Architectural: www.architectural.masonite.com/#sle.
    2. VT Industries, Inc: www.vtindustries.com/#sle.
    3. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), AWMAC/WI (NAAWS) or WDMA I.S. 1A.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
   3. Wood veneer facing for field transparent finish as indicated on drawings.

2.3 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type structural composite lumber core (SCLC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.4 DOOR FACINGS

A. Veneer Facing for Transparent Finish: White birch, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Any option allowed by quality standard for grade.

B. Facing Adhesive: Type I - waterproof.

2.5 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

E. Provide edge clearances in accordance with the quality standard specified.

2.6 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
   1. Transparent:
      a. System - TR-6, Catalyzed Polyurethane.
      b. Stain: As selected by Architect.
      c. Sheen: Flat.

B. Factory finish doors in accordance with approved sample.

2.7 ACCESSORIES

A. Hollow Metal Door Frames: See Section 08 11 13.
B. Glazed Openings:
C. Door Window Frames: Door window frames with glazing securely fastened within door opening.
D. Glazing: See Section 08 80 00.
E. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
F. Door Hardware: See Section 08 71 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.
C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
    1. Install fire-rated doors in accordance with NFPA 80 requirements.
    2. Install exterior doors in accordance with ASTM E2112.
B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
C. Field-Finished Doors: Trimming to fit is acceptable.
    1. Adjust width of non-rated doors by cutting equally on both jamb edges.
    2. Trim maximum of 3/4 inch (19 mm) off bottom edges.
    3. Trim fire-rated doors in strict compliance with fire rating limitations.
D. Use machine tools to cut or drill for hardware.
E. Coordinate installation of doors with installation of frames and hardware.
F. Coordinate installation of glazing.
G. Important TAS & ADA Compliance Note
    1. Critical dimension for final in-place location of the bottom of the GLASS is a Maximum 3’-7” (43 inches (109.22 cm)) Above Finished Floor (AFF). Not from the bottom of the door and not to the frame of the window. The dimension is from Finished Floor to the bottom edge of the visible Glass. No exceptions.

3.3 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.
B. Comply with specified quality standard for telegraphing, warp, and squareness.
C. Comply with TAS and ADA Standards for accessibility requirements.

3.4 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall mounted access units.
B. Ceiling mounted access units.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 09 21 16 - Gypsum Board Assemblies: Openings in gypsum board walls and ceilings.
C. Division 22 Sections: Plumbing components requiring access.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2020a.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
D. Manufacturer's Installation Instructions: Indicate installation requirements.
E. Manufacturer's Qualification Statement.
F. Project Record Documents: Record actual locations of each access unit.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.7 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design. The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 2500 - Substitution Procedures AND Section 01 6000 - Product Requirements for substitution procedures.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units in Wet Areas:
    1. Location: As indicated on drawings.
    2. Panel Material: Stainless steel, Type 304.
    3. Size: 12 inch by 12 inch (305 mm by 305 mm).
    4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
    5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
    6. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
B. Ceiling-Mounted Units:
    1. Location: As indicated on drawings.
    2. Panel Material: Stainless steel, Type 304.
    3. Size: 12 inch by 12 inch (305 mm by 305 mm).
    4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.2 WALL AND CEILING MOUNTED ACCESS UNITS

A. Manufacturers:
    1. Activar Construction Products Group - JL Industries: www.activarcpg.com/#sle.
    2. ACUDOR Products Inc: www.acudor.com/#sle.
    3. Babcock-Davis: www.babcockdavis.com/#sle.
    4. Nystrom, Inc: www.nystrom.com/#sle.

5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
   1. Material: Stainless steel, Type 304.
   2. Style: Exposed frame with door surface flush with frame surface.
   3. Door Style: Single thickness with rolled or turned in edges.
   4. Frames: 16 gage, 0.0598 inch (1.52 mm), minimum thickness.
   5. Single Steel Sheet Door Panels: 1/16 inch (1.6 mm), minimum thickness.
   6. Stainless Steel Finish: No. 4 brushed finish.
   7. Hardware:
      a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
      b. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that rough openings are correctly sized and located.
B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.
B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.3 INSTALLATION

A. Install units in accordance with manufacturer's instructions.
B. Install frames plumb and level in openings, and secure units rigidly in place.
C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Overhead coiling doors, operating hardware, exterior; manually operated.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 05 50 00 - Metal Fabrications: Support framing.
C. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
B. ITS (DIR) - Directory of Listed Products current edition.
C. UL (DIR) - Online Certifications Directory Current Edition.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide general construction, electrical equipment, and component connections and details.
C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
D. Samples: Submit two slats, 6 inch (150 mm) in size illustrating shape, color and finish texture.
E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

F. Manufacturer's Qualification Statement.
G. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience and approved by manufacturer.
C. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

1.7 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.
B. Provide three year manufacturer warranty. Include coverage for electric motor.

1.8 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Overhead Coiling Doors:
   1. Cornell Iron Works, Inc: www.cornelliron.com/#sle.
   2. Overhead Door Corporation: www.overheaddoor.com.
   3. The Cookson Company: www.cooksondoor.com/#sle.
   4. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

2.2 COILING DOORS

A. Exterior Coiling Doors: Steel slat curtain.
   1. Capable of withstanding positive and negative wind loads of 20 psf (940 Pa), without undue deflection or damage to components.

2. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 7.7 (RSI-value of 1.).
3. Nominal Slat Size: 2-5/8 inches (67 mm) wide x required length.
4. Finish: Factory painted, color as selected.
5. Guide, Angles: Galvanized steel.
6. Hood Enclosure: Manufacturer's standard; primed steel.
7. Manual hand chain lift operation.
8. Mounting: As indicated on drawings.
9. Locking Devices: Lock and latch handle on outside.
10. Insulated Vision Lites: Provide with uniformly spaced openings.
    a. Size: 3 inch by 5/8 inch (76 mm by 16 mm)
    b. Provide with dual wall polycarbonate lites.

2.3 MATERIALS AND COMPONENTS

A. Curtain Construction: Interlocking slats.
   1. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
   2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
B. Steel Slats: Minimum thickness, 22 gage, 0.0336 inch (0.853 mm); ASTM A653/A653M galvanized steel sheet.
C. Guides - Angle: ASTM A36/A36M metal angles, size as indicated.
D. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

A. Install units in accordance with manufacturer's instructions.
B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
E. Install enclosure and perimeter trim.

3.3 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.
B. Maximum Variation From Plumb: 1/16 inch (1.6 mm).
C. Maximum Variation From Level: 1/16 inch (1.6 mm).
D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft (3.2 mm per 3 m) straight edge.

3.4 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean installed components.
B. Remove labels and visible markings.

END OF SECTION

SECTION 08 38 13

FLEXIBLE STRIP DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flexible PVC strip doors.
B. Door accessories.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 08 12 13 - Hollow Metal Frames: Flat-faced frame.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's technical information for each type of door specified, including details about materials, components, profiles, and finishes; include:
   1. Preparation and installation instructions and methods.
   2. Storage and handling requirements and recommendations.
   3. Operation and maintenance data.
C. Manufacturer's Qualification Statement.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver product in manufacturer's original unopened packages with label legible and intact.
B. Store products at project site under cover and elevated above grade, following manufacturer's instructions.

PART 2 - PRODUCTS

2.1 FLEXIBLE TRAFFIC DOORS

A. Transparent Flexible Strip Doors : Door curtain made of transparent extruded PVC strips.
   1. Material: Clear, flexible strips of non-phthalate polyvinylchloride with UV absorbers; 0.08 inch (2.0 mm) thick; prepunched holes for attachment to header.
   2. Strip Width: 8 inches (203 mm).

2.2 ACCESSORIES

A. Header: Universal mount 14 gauge, 0.0785 inch (1.99 mm) galvanized header. Pre-studded at 2 inches (51 mm) o.c. with retainer plates and lock nuts.
B. Provide fasteners and other hardware as recommended by manufacturer for complete installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that jambs and frames are square and plumb.
B. Verify that opening is ready to receive work and opening dimensions and clearances are as indicated on drawings.

3.2 INSTALLATION

A. Install doors with clearances, anchors, hardware, and accessories according to the manufacturer's instructions and as specified.
B. Install door header level, and properly aligned.

3.3 CLEANING

A. Clean surfaces using methods as recommended by manufacturer.

END OF SECTION

SECTION 08 43 13

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.
B. Aluminum doors and frames.
C. Weatherstripping.
D. Door hardware.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
C. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site 2015.
B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems 2015.
C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).
E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2020.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.
H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014.
I. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
D. Samples: Submit two samples 10 x 10 inches (250 x 250 mm) in size illustrating finished aluminum surface, glass, glazing materials.
E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
F. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
I. Manufacturer's Qualification Statement.
J. Installer's Qualification Statement.
K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.9 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.

1.11 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Aluminum-Framed Storefronts Manufacturers:
   1. Kawneer North America: www.kawneer.com/#sle.
   2. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
   3. YKK AP America Inc: www.ykkap.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Front-Set Style, Thermally-Broken:
   1. Basis of Design: Kawneer, Series TriFab VersaGlaze 451T.
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep).

2.3 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING AT INTERIOR

A. Center-Set Style:
   1. Basis of Design: Kawneer TriFab VG 450.
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep).

2.4 BASIS OF DESIGN -- SWINGING DOORS

A. Medium Stile, Monolithic Glazing:
   1. Basis of Design: Kawneer 350 Swing Door, Medium stile.
   2. 3-1/2 inch (89 mm) vertical face dimension.
   3. Thickness: 1-3/4 inches (43 mm).

B. Medium Stile, Insulating Glazing, Thermally-Broken:
   1. Basis of Design: Kawneer Insulclad 360 Swing Door, Medium stile.
   2. 4-1/16 inch (103.2 mm) vertical face dimension.
   3. Thickness: 1-3/4 inches (43 mm).

2.5 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Class I natural anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
   2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   5. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
   6. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
   7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements:
   1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
      a. Design Wind Loads: Comply with requirements of ASCE 7.
      b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf (390 Pa).
   3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft (0.3 L/sec sq m) of wall area, when tested in accordance with ASTM E283 at 6.27 psf (300 Pa) pressure differential across assembly.

2.6 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.

2. Glazing Stops: Flush.

B. Glazing: As specified in Section 08 80 00.

C. Swing Doors: Glazed aluminum.
1. Thickness: 1-3/4 inches (43 mm).
2. Bottom Rail: 10 inches (254 mm) wide.
3. Glazing Stops: Square.
4. Finish: Same as storefront.

2.7 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

D. Glazing Accessories: As specified in Section 08 80 00.

2.8 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

2.9 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: As specified in Section 08 71 00.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
I. Set thresholds in bed of sealant and secure.
J. Install hardware using templates provided.
   1. See Section 08 71 00 for hardware installation requirements.
K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.4 FIELD QUALITY CONTROL

A. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
B. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.5 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.6 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.
B. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

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. Mechanical and electrified door hardware for:
      a. Swinging doors.
      b. Sliding doors.
      c. Gates.
   2. Electronic access control system components, including:
      a. Biometric access control reader.
      b. Electronic access control devices.
   3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
   4. Lead-lining door hardware items required for radiation protection at door openings.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:
   1. Windows
   2. Cabinets (casework), including locks in cabinets
   3. Signage
   4. Toilet accessories
   5. Overhead doors

C. Related Sections:
   1. Division 01 Section “Alternates” for alternates affecting this section.
   2. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
   3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
   4. Division 13 Section “Radiation Protection” for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
   5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
   6. Division 28 sections for coordination with other components of electronic access control system.

1.3 REFERENCES

A. UL - Underwriters Laboratories
   1. UL 10B - Fire Test of Door Assemblies
   2. UL 10C - Positive Pressure Test of Fire Door Assemblies
   3. UL 1784 - Air Leakage Tests of Door Assemblies
   4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute
   1. Sequence and Format for the Hardware Schedule
   2. Recommended Locations for Builders Hardware

3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute
1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.4 SUBMITTALS

A. General:
1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.

B. Action Submittals:
1. Product Data: Product data including manufacturers’ technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

a. Wiring Diagrams: For power, signal, and control wiring and including:
1) Details of interface of electrified door hardware and building safety and security systems.
2) Schematic diagram of systems that interface with electrified door hardware.
3) Point-to-point wiring.
4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
a. Door Index; include door number, heading number, and Architects hardware set number.
b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
c. Type, style, function, size, and finish of each hardware item.
d. Name and manufacturer of each item.
e. Fastenings and other pertinent information.
f. Location of each hardware set cross-referenced to indications on Drawings.
g. Explanation of all abbreviations, symbols, and codes contained in schedule.
h. Mounting locations for hardware.
i. Door and frame sizes and materials.
j. Name and phone number for local manufacturer's representative for each product.
k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches,

magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.

1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:
   a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
   b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
      1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.

   f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:
1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:

   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:

   a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
   b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
   c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:
1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Name, address, and phone number of local representative for each manufacturer.
d. Parts list for each product.
e. Final approved hardware schedule, edited to reflect conditions as-installed.
f. Final keying schedule
g. Copies of floor plans with keying nomenclature
h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE

A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
   1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
      a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
   2. Where products indicate "acceptable manufacturers" or "acceptable manufacturers and products", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.

B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
   1. Warehousing Facilities: In Project's vicinity.
   2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
   3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
   4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.

      a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.

D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
   2. Can provide installation and technical data to Architect and other related subcontractors.
   3. Can inspect and verify components are in working order upon completion of installation.

4. Capable of producing wiring diagrams.
5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.

J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
2. Maximum opening-force requirements:
   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
   b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
   c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.

K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Attendees: Owner, Contractor, Architect, Installer, Owner's security consultant, and Supplier’s Architectural Hardware Consultant.
2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
   a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
   b. Preliminary key system schematic diagram.
   c. Requirements for key control system.
   d. Requirements for access control.
   e. Address for delivery of keys.

L. Pre-installation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

M. Coordination Conferences:
1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
   a. Attendees: Door hardware supplier, door hardware installer, Contractor.
   b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
   a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner**,** Owner's security consultant**,** Architect and Contractor.
   b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
   1. Deliver each article of hardware in manufacturer's original packaging.
C. Project Conditions:
   1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
   2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
D. Protection and Damage:
   1. Promptly replace products damaged during shipping.
   2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
   3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
F. Deliver keys to Owner by registered mail or overnight package service.

1.7 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.
F. Direct shipments not permitted, unless approved by Contractor.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
      a. Closers:
         1) Mechanical: 30 years.
      b. Automatic Operators: 2 year.
      c. Exit Devices:
         1) Mechanical: 3 years.
         2) Electrified: 1 year.
      d. Locksets:
         1) Mechanical: 3 years.
         2) Electrified: 1 year.
      e. Key Blanks: Lifetime
   2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE

A. Maintenance Tools:
   1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”
   1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.
B. Approval of manufacturers and/or products other than those listed as ”Scheduled Manufacturer ” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
C. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

A. Fasteners
   1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
   2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
   3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
   4. Install hardware with fasteners provided by hardware manufacturer.
B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
   1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
C. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
   1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
   2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
   3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
   4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.3 HINGES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Ives 5BB series
   2. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series
B. Requirements:
   1. Provide five-knuckle, ball bearing hinges conforming to ANSI/BHMA A156.1.
   2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
      a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
      b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
   3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
      a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
      b. Interior: Heavy weight, steel, 5 inches (127 mm) high
   4. 2 inches or thicker doors:

a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

a. Steel Hinges: Steel pins
b. Non-Ferrous Hinges: Stainless steel pins
c. Out-Swinging Exterior Doors: Non-removable pins
d. Out-Swinging Interior Lockable Doors: Non-removable pins
e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
11. Provide mortar guard for each electrified hinge specified.
12. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.4 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:
1. Scheduled Manufacturer and Product: Best 9K Series

B. Requirements:
1. Provide cylindrical locks conforming to the following standards and requirements:
a. ANSI/BHMA A156.2 Series 4000, Grade 1.
b. UL 10C for 4’-0” x 10’-0” 3-hour fire door.
c. Florida Building Code (ASTM E330, E1886, E1996) and Miami Dade (TAS 201, 202, 203) requirements for hurricanes.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
b. Cycle life - tested to minimum 10 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.

7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
   a. Lever Design: Dane.
   b. Knurled finishes at openings serving rooms considered to be hazardous.

2.5 EXIT DEVICES

A. Low profile push bar exit devices
B. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Von Duprin 99-series.
C. The maximum exit device projection shall be a maximum of 3-1/16" when activated. The exit device bar shall have an average minimum thickness of .201". The pushpad surface shall be constructed of stainless steel; pushpads with plastic or Lexan coatings shall not be acceptable. Nylon bearings and stainless steel springs shall be used for long life and durability. Only torsion or compression springs are acceptable. Extension type springs are not acceptable. All device covers shall be of cast brass, deep drawn steel or stainless steel. Latchbolts shall be of stainless steel and shall have a deadlocking latch for extra security, except at full-glass or two-light glass doors requiring narrow stile device. Mounting screws shall be concealed to deter tampering. All ferrous parts shall be zinc coated to prevent rusting.
D. Single point, one quarter turn hex dogging shall be standard on panic listed devices. Optional key cylinder dogging shall be available, and furnished if so indicated in the hardware sets, on panic listed devices. Devices with hex key dogging shall be easily field converted to cylinder dogging.
E. All devices shall be listed by Underwriters Laboratories for safety as panic hardware. Fire rated devices shall be UL listed for A label and lesser class doors, 4' x 8' single and 8 x 8' pair. The model number shall be located on the end cap; devices having the model number located other than on the end cap shall not be acceptable.
F. All exit devices shall have a unitized installation feature and may be cut in the field to size. Devices shall be closed on all sides with no pinch points. The push pad shall be designed to prevent pinching of the fingers when depressed.
G. Exit Device trim to be through bolted. Lever trim to be heavy duty forged escutcheon with free-wheeling levers.
H. All exit devices shall conform to Federal Specification FF-H-1820, and be certified as meeting ANSI A156.3, Grade 1 requirements.

2.6 CYLINDERS

A. Manufacturers:
   1. Scheduled Manufacturer: ~~Best – Cormax~~ **Standard Construction Cores**
   2. Acceptable Manufacturers: ~~No Substitution~~ **Best, Falcon, Yale**
B. Requirements:
   1. ~~Provide permanent cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein~~. **Permanent Cores Shall be Provided by TxDot**
   2. Replaceable Construction Cores.
      a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         1) 3 construction control keys
         2) 12 construction change (day) keys.

3) **All Cylinder Cores shall be 7 Pin Cores**

b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.7 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
B. Provide cylinders/cores keyed into Owner's existing factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
C. Requirements:
   1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      a. Master Keying system as directed by the Owner.
   2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   3. Provide keys with the following features:
      a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      b. Patent Protection: Keys and blanks protected by one or more utility patent(s).
   4. Identification:
      a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include actual key cuts.
      b. Identification stamping provisions must be approved by the Architect and Owner.
      c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
      d. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.
      e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
   5. Quantity: Furnish in the following quantities.
      a. Change (Day) Keys: 3 per cylinder/core.
      b. Master Keys: 6.

2.8 KEY CONTROL SYSTEM

A. Manufacturers:
   1. Scheduled Manufacturer: Telkee
   2. Acceptable Manufacturers: HPC, Lund
B. Requirements:
   1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
b. Provide hinged-panel type cabinet for wall mounting.

2.9 DOOR CLOSERS

A. Manufacturers and Products:
1. Scheduled Manufacturer and Product: LCN 4050 and 1450 series (as specified)

B. Requirements:
1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
2. Provide door closers with fully hydraulic, full rack and pinion action cast iron cylinder.
3. Closer Body: 1-1/4 inch (32 mm) diameter, with 5/8 inch (16 mm) diameter heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. OPTION LCN No Substitute: Cylinder body to have "FAST" power adjust speed dial to visually indicate spring power.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Pressure Relief Valve (PRV) Technology: not permitted.
8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.10 DOOR TRIM

A. Manufacturers:
1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:
1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.11 PROTECTION PLATES

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: Burns, Rockwood
B. Requirements:
   1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
   2. Sizes of plates:
      a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
      b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
      c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.12 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:
   1. Scheduled Manufacturers: Glynn-Johnson
   2. Acceptable Manufacturers: Rixson, Sargent
B. Requirements:
   1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
   2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
   3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
   4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.13 DOOR STOPS AND HOLDERS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: Burns, Rockwood
B. Provide door stops at each door leaf:
   1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
   2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
   3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.14 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:
   1. Scheduled Manufacturer: Zero International
   2. Acceptable Manufacturers: National Guard, Reese
B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
   a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
   b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.15 SILENCERS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: Burns, Rockwood
B. Requirements:
   1. Provide "push-in" type silencers for hollow metal or wood frames.
   2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
   3. Omit where gasketing is specified.

2.16 FINISHES

A. Finish: BHMA 626/652 (US26D); except:
   1. Hinges at Exterior Doors: BHMA 630 (US32D)
   2. Continuous Hinges: BHMA 630 (US32D)
   3. Continuous Hinges: BHMA 628 (US28)
   4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
   5. Protection Plates: BHMA 630 (US32D)
   6. Overhead Stops and Holders: BHMA 630 (US32D)
   7. Door Closers: Powder Coat to Match
   8. Wall Stops: BHMA 630 (US32D)
   9. Latch Protectors: BHMA 630 (US32D)
   10. Weatherstripping: Clear Anodized Aluminum
   11. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Where on-site modification of doors and frames is required:
   1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
   2. Field modify and prepare existing door and frame for new hardware being installed.
   3. When modifications are exposed to view, use concealed fasteners, when possible.
   4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
      a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
      b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
      c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
   1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
   2. Custom Steel Doors and Frames: HMMA 831.
   3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Replace construction cores with permanent cores as indicated in keying section.
J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.
K. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
   1. Conduit, junction boxes and wire pulls.
   2. Connections to and from power supplies to electrified hardware.
   3. Connections to fire/smoke alarm system and smoke evacuation system.

4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect's opening number.

L. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
M. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
N. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
   1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
T. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
   1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
   1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
   2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
   3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.
B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.
B. Hardware Sets:

Hardware Group No. 001
For use on Door #(s):

123C	123D	124D	124E	123E	123F
125C	128B	128C	130C	131B	

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MORTISE CYLINDER	TYPE AS REQ TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	HARDWARE	REMAINDER OF HARDWARE BY DOOR MFG		

Hardware Group No. 103
For use on Door #(s):

104	105	106

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		ENTRANCE/OFFICE LOCK	9K3 7 AB 15D STK	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 201
For use on Door #(s):
118 120 127 132
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		STOREROOM LOCK	9K3 7 D 15D S3	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	1450 REG OR PA AS REQ FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 201C
For use on Door #(s):
121 122
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		STOREROOM LOCK	9K3 7 D 15D S3	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	1450 SCUSH TBSRT	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 203S
For use on Door #(s):
119
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		STOREROOM LOCK	9K3 7 D 15D S3	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	OH STOP	90S	630	GLY
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 204S
For use on Door #(s):
128A
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		STOREROOM LOCK	9K3 7 r 15D S3	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 212S
For use on Door #(s):
125B 126
Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1		STOREROOM LOCK	9K3 7 D 15D S3	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
2	EA	OH STOP	90S	630	GLY
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 301
For use on Door #(s):
110 112
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		PRIVACY LOCK	9K3 7 L 15D STK	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	1450 REG OR PA AS REQ FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 501
For use on Door #(s):
117A
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		CLASSROOM LOCK	9K3 7 R 15D STK	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	1450 REG OR PA AS REQ FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 507
For use on Door #(s):
130B
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1		CLASSROOM LOCK	9K3 7 R 15D STK	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	1450 REG OR PA AS REQ FC	689	LCN
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 701CR
For use on Door #(s):
124B
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224HD - TYPE AS REQ - SIZE AS REQ	628	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-06-SNB	626	VON
1	EA	RIM CYLINDER	TYPE AS REQ TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	1450 SCUSH TBSRT	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 801
For use on Door #(s):
113A
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224HD - TYPE AS REQ - SIZE AS REQ	628	IVE
1	EA	PUSH PLATE	8200 4" X 16"	626	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"	626	IVE
1	EA	SURFACE CLOSER	1450 REG OR PA AS REQ FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. 807
For use on Door #(s):
113B 114
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224HD - TYPE AS REQ - SIZE AS REQ	628	IVE
1	EA	PUSH PLATE	8200 4" X 16"	626	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"	626	IVE
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	1450 REG OR PA AS REQ FC	689	LCN
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER

Hardware Group No. C711AC
For use on Door #(s):
103
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224HD X EPT PREP - TYPE AS REQ - SIZE AS REQ	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-L-NL-06-CON-SNB 24 VDC	626	VON
1	EA	RIM CYLINDER	TYPE AS REQ TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	1450 SCUSH TBSRT	693	LCN
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	PS902 - 2RS-FA (COMBINE POWER SUPPLIES AS REQ)	LGR	VON
1	EA	POWER SUPPLY	POWER SUPPLY FOR READER BY SECURITY CONTRACTOR		
1	EA	READER	READER BY SECURITY CONTRACTOR		
1	EA	SEAL	SEAL BY DOOR MFG		

Hardware Group No. C711R
For use on Door #(s):
115
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224HD X EPT PREP - TYPE AS REQ - SIZE AS REQ	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-99-L-NL-F-06-CON-SNB 24 VDC	626	VON
1	EA	RIM CYLINDER	TYPE AS REQ TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	90 DEG OFFSET PULL	8190 10" HD	630	IVE
1	EA	SURFACE CLOSER	1450 REG OR PA AS REQ FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S (AT FIRE RATED OR USE SILENCERS)	S-Cl	ZER
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	PS902 - 2RS-FA (COMBINE POWER SUPPLIES AS REQ)	LGR	VON
1	EA	POWER SUPPLY	POWER SUPPLY FOR READER BY SECURITY CONTRACTOR		
1	EA	READER	READER BY SECURITY CONTRACTOR		

Hardware Group No. C715 - CHANGED THRESHOLD DOORS 107 & 117B ON 05-05-2021
For use on Door #(s):

107	117B	123A	123B	124A	124C
129	130A	131A			

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224HD X EPT PREP - TYPE AS REQ - SIZE AS REQ	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-OP-110MD-CON-SNB 24 VDC	626	VON
1	EA	RIM CYLINDER	TYPE AS REQ TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	90 DEG OFFSET PULL	8190 10" HD	630	IVE
1	EA	SURFACE CLOSER	4050 SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	328 X (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39 X LENGTH REQ	A	ZER
1	EA	THRESHOLD	65A-223 (EXCEPT DOOR 107 & 117B)	A	ZER
1	EA	HALF SADDLE THRESHOLD	1074A-223 (DOOR 107 & 117B)	A	ZER
1	EA	RAIN DRIP	142 + 4" DW	A	ZER
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	PS902 - 2RS-FA (COMBINE POWER SUPPLIES AS REQ)	LGR	VON
1	EA	POWER SUPPLY	POWER SUPPLY FOR READER BY SECURITY CONTRACTOR		
1	EA	READER	READER BY SECURITY CONTRACTOR		

Hardware Group No. C715A – CHANGED THRESHOLD ON 05-05-2021
For use on Door #(s):
102
Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224HD X EPT PREP - TYPE AS REQ - SIZE AS REQ	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-OP-110MD-CON-SNB 24 VDC	626	VON
1	EA	RIM CYLINDER	TYPE AS REQ TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	626	BES
1	EA	90 DEG OFFSET PULL	8190 10" HD	630	IVE
1	EA	SURFACE CLOSER	4050 SCUSH TBSRT	689	LCN
1	EA	DOOR SWEEP	39 X LENGTH REQ	A	ZER
1	EA	HALF SADDLE THRESHOLD	1074A-223	A	ZER
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	PS902 - 2RS-FA (COMBINE POWER SUPPLIES AS REQ)	LGR	VON
1	EA	READER	READER BY SECURITY CONTRACTOR		
1	EA	SEAL	SEAL BY DOOR MFG		

Hardware Group No. 102 - GATES

For use on Door #(s):
G101 G102

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	SET	HINGES & CLOSER	MAMMOTH 180 HEAVY DUTY	689	LOC
1	EA	ELECTRIC STRIKE	6300 EB FSE 24VDC	630	VON
1	EA	EXIT DEVICE W/ REX	WP/RX-99-WH-SEC-NL/OP	626	VON
1	EA	RIM CYLINDER	C953	626	FAL
1	EA	CONSTRUCTION CORE	AS REQUIRED	626	FAL
1	EA	VANDAL RESISTANT TRIM	VR910-NL	BLK	IVE
1	EA	FLOOR STOP	FS18L	BLK	IVE
1	EA	POWER LOOP	798-18C (FOR USE WITH REX)	ZIN	SCE
		STRIKE MOUNTING BOX	PROVIDED BY GATE SUPPLIER		
		BALANCE HARDWARE	PROVIDED BY GATE SUPPLIER		
		DOOR CONTACT	DOOR CONTACT BY SECURITY CONTRACTOR		
		POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR		
		READER	READER BY SECURITY CONTRACTOR		

End of Section

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.
B. Glazing units.
C. Glazing compounds.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
C. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.
D. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015.
C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2019).
E. ASTM C1036 - Standard Specification for Flat Glass 2021.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
G. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021.
I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.
J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2010.
K. GANA (GM) - GANA Glazing Manual 2008.
L. GANA (SM) - GANA Sealant Manual 2008.
M. GANA (LGRM) - Laminated Glazing Reference Manual 2009.
N. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
O. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2016).
P. ITS (DIR) - Directory of Listed Products current edition.
Q. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2017.
R. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2014, with Errata (2017).
S. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2017.
T. UL (DIR) - Online Certifications Directory Current Edition.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
D. Samples: Submit two samples 4 by 4 inch (100 by 100 mm) in size of glass units.
E. Samples: Submit 4 inch (100 mm) long bead of glazing sealant, color as selected.
F. Certificate: Certify that products of this section meet or exceed specified requirements.
G. Manufacturer's qualification statement.
H. Installer's qualification statement.
I. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (GM), GANA (GM), GANA (GM), and GANA (GM) for glazing installation methods. Maintain one copy on site.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience and approved by manufacturer.

1.8 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.
B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

1.10 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Float Glass Manufacturers:
    1. Basis of Design: Vitro Architectural Glass; www.vitroglazing.com.
    2. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
    3. Guardian Glass, LLC: www.guardianglass.com/#sle.
    4. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
        a. See article in PART 1 above entitled "Available Manufacturers".

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

2.4 INSULATING GLASS UNITS

A. Manufacturers:
   1. Basis of Design: Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Spacer Color: Black.
   4. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone sealant as secondary seal applied around perimeter.
   5. Color: Black.

6. Purge interpane space with dry air, hermetically sealed.

C. Type IG-Insulating Glass Units: Vision glass, double glazed.
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
      a. Tint: Optigray.
      b. Coating: Solarban 70, on #2 surface.
   4. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
      a. Tint: Clear.
   5. Total Thickness: 1 inch (25.4 mm).
   6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.26, nominal.
   7. Visible Light Transmittance (VLT): 46 percent, nominal.
   8. Solar Heat Gain Coefficient (SHGC): 0.23, nominal.
   9. Visible Light Reflectance, Outside: 8 percent, nominal.
   10. Glazing Method: Dry glazing method, gasket glazing.

D. Insulating Glass Units: Safety glazing.
   1. Applications:
      a. Glazed lites in exterior doors.
      b. Glazed sidelights and panels next to doors.
      c. Other locations required by applicable federal, state, and local codes and regulations.
      d. Other locations indicated on drawings.
   2. Space between lites filled with air.
   3. Glass Type: Same as Type IG-1 except use fully tempered float glass for both outboard and inboard lites.
   4. Total Thickness: 1 inch (25.4 mm).
   5. Glazing Method: Dry glazing method, gasket glazing.

2.5 GLAZING UNITS

A. Monolithic Interior Vision Glazing, Type **G-1**:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6.4 mm), nominal.
   5. Glazing Method: Dry glazing method, gasket glazing.

B. Fire-Resistance-Rated Glazing, Type G-2: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period exceeding 45 minutes.
   1. Applications:
      a. Glazing in fire-rated door assembly.
      b. Glazing in fire-rated window assembly.
      c. Glazing in sidelites, borrowed lites, and other glazed openings in fire-rated wall assemblies.
      d. Other locations as indicated on drawings.
   2. Glass Type: Multi-laminate annealed glass with intumescent fire retardant interlayers.

3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
4. Safety Glazing Certification: 16 CFR 1201 Category II.
5. Fire-Rating Period: 90 minutes.
6. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on fire-resistance-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
    a. "W" - meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
    b. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
    c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
    d. "T" - meets temperature rise of not more than 450 degrees F (232 degrees C) above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
    e. "XXX" - placeholder that represents fire-rating period, in minutes.

2.6 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
B. Spacer Shims: Silicone, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
C. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
B. Verify that the minimum required face and edge clearances are being provided.
C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
B. Remove nonpermanent labels immediately after glazing installation is complete.
C. Clean glass and adjacent surfaces after sealants are fully cured.
D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.6 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 09 05 61

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile.
   2. Carpet tile.
   3. Thin-set ceramic tile.

B. Preparation of new concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Patching compound.

E. Remedial floor coatings.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections below is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.

B. Section 03 30 00 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.4 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) 2020b.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete 2020.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2019, with Editorial Revision (2020).
D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2016a.
E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.6 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.
B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's qualification statement.
   2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
   3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
C. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Product data for recommended remedial coating.
   7. Submit report to Architect.
   8. Submit report not more than two business days after conclusion of testing.
D. Adhesive Bond and Compatibility Test Report.

1.7 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
D. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.

2. Confirm date of start of testing at least 10 days prior to actual start.
3. Allow at least 4 business days on site for testing agency activities.
4. Achieve and maintain specified ambient conditions.
5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
B. Deliver materials in manufacturer's packaging; include installation instructions.
C. Keep materials from freezing.

1.9 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.1 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

PART 3 EXECUTION

3.1 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:
   1. Preliminary cleaning.

2. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
5. Specified remediation, if required.
6. Patching, smoothing, and leveling, as required.
7. Other preparation specified.
8. Adhesive bond and compatibility test.
9. Protection.

B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.2 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
B. Do not use solvents or other chemicals for cleaning.

3.3 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
C. Test in accordance with ASTM F1869 and as follows.
D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
F. Report: Report the information required by the test method.

3.4 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
C. Test in accordance with ASTM F2170 Procedure A and as follows.
D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
F. Report: Report the information required by the test method.

3.5 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
    1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
    2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
    3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.6 PREPARATION

A. See individual floor covering section(s) for additional requirements.
B. Comply with requirements and recommendations of floor covering manufacturer.
C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
D. Do not fill expansion joints, isolation joints, or other moving joints.

3.7 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.8 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Metal channel ceiling framing.
D. Gypsum sheathing.
E. Gypsum wallboard.
F. Joint treatment and accessories.
G. Water-resistive barrier over exterior wall sheathing.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
C. Section 05 40 00 - Cold-Formed Metal Framing: Structural steel stud framing.
D. Section 06 10 53 - Miscellaneous Rough Carpentry: Mounting boards, concealed wood blocking, nailers, and supports.
E. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
F. Section 07 27 20 - Membrane Flashing.
G. Section 07 27 26 - Fluid-Applied Membrane Air Barrier - Fluid-Applied Air Barrier Assembly
H. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
I. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.
C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2020.
G. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base 2019.
H. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.
I. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing 2018.
J. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
K. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels 2019, with Ediorial Revision (2020).
L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.
M. GA-214 - Recommended Levels of Finish - Gypsum Board, Glass Mat and Fiber-Reinforced Gypsum Panels 2015.
N. GA-216 - Application and Finishing of Gypsum Panel Products 2018.
O. GA-610 - Fire Resistance Provided by Gypsum Board Membrane Protection current.
P. UL (FRD) - Fire Resistance Directory Current Edition.
Q. PDCA - Standard P1 - Touch-Up Painting and Damage Repair: Financial Responsibility and Definition of a Properly Painted Surface (Painting and Decorating Contractors of America) 2007.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
C. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
D. Buy American Certification: Upon delivery of product, provide notarized original of TxDOT Form 1818 (aka Form D-9-USA-1) with the proper attachments for verification of compliance.

1.6 QUALITY ASSURANCE

A. Buy America: Manufacturer shall provide products complying with the latest provisions of Buy America as listed at 23 CFR 635.410. For steel and iron materials, all manufacturing processes, including application of a coating, must occur in the United States.

B. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum three years of experience.
C. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

1.7 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    a. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
    1. See PART 3 for finishing requirements.
B. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code.
    1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.2 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
    1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
    2. Marino: www.marinoware.com.
    3. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
    4. SCAFCO Corporation: www.scafco.com/#sle.
    5. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
        a. See article in PART 1 above entitled "Available Manufacturers".
B. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
    1. Studs: C-shaped with knurled or embossed faces.
    2. Runners: U shaped, sized to match studs.
    3. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
    4. Furring Members: U-shaped sections, minimum depth of 3/4 inch (19.1 mm).

C. Metal Studs at walls finished with ceramic tile, porcelain tile, solid surface material (SSM), and other material finish used on "wet walls" (walls with water pipe or drain pipe penetrations) shall be galvanized and a minimum of 20 gage (33 mil) thick, unless required to be heavier. Galvanized in accordance with ASTM A653/A653M G60/Z180 coating.

D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

E. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

F. Framing systems which are not covered by or are outside the parameters of ASTM C645 and ASTM C754 shall be submitted with Shop Drawings with design, drawings, and calculations signed and sealed by a Structural Engineer registered to practice in the jurisdiction where the project is located.

G. Drywall Ceiling Grid System: Suspended Grid structure comprising of Main Runners and Cross Tees, including Wall Moldings and Transition Trims, as per manufacturer's instructions may be used in lieu of other metal framing. Provide engineering data with structural engineers seal and signature when requested by authority having jurisdiction.
   1. Armstrong Drywall Grid Systems; www.armstrong.com.
   2. USG Drywall Suspension Systems (United States Gypsum Company (USG), Chicago, IL.); www.usg.com;
   3. Rockfon (Chicago Metallic) Concealed Grid Ceilings; 4849 S. Austin Ave., Chicago, IL 60638 USA; T: (800) 323-7164; F (-800) 222-3744; Email. cs@rockfon.com.
   4. Substitutions: See Section 01 2500 - Substitution Procedures and Section 01 6000 - Product Requirements.
      a. See article in PART 1 above article titled "Available Manufacturers".

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
   3. National Gypsum Company: www.nationalgypsum.com/#sle.
   4. USG Corporation: www.usg.com/#sle.
   5. Substitutions: See Section 01 2500 - Substitution Procedures and Section 01 6000 - Product Requirements.
      a. See article in PART 1 above article titled "Available Manufacturers".

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.

4. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
5. Thickness:
   a. Vertical Surfaces: 5/8 inch (16 mm).
   b. Ceilings: 5/8 inch (16 mm).

C. Backing Board For Wet Areas: Coated glass mat water-resistant gypsum backing board (aka tile backer board).
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
2. Use the same backing board at all wall and shower ceiling surfaces in the balance of the Wet Area which is not covered by tile, shower/tub surrounds, or other solid covering.
   a. Skim coat exposed surfaces of backing boards as recommended by manufacturer.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch (16 mm).

D. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
3. Core Type: Regular.
4. Regular Board Thickness: 1/2 inch (13 mm).
5. Edges: Square.
6. Glass Mat Faced Products:
   a. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
   b. National Gypsum Company; Gold Bond eXP Sheathing: www.nationalgypsum.com/#sle.
   c. USG Corporation; USG Securock Brand Ultralight Glass-Mat Sheathing: www.usg.com/#sle.
   d. Substitutions: See Section 01 2500 - Substitution Procedures AND Section 01 6000 - Product Requirements.
      1) See article in PART 1 above entitled "Available Manufacturers".

2.4 Gypsum Wallboard ACCESSORIES

A. Acoustic Insulation: As specified in Section 07 21 00.
B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
C. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Corner Beads: Low profile, for 90 degree outside corners.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.

2. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
3. Joint Compound: Drying type, vinyl-based, ready-mixed.
4. Joint Compound: Setting type, field-mixed.

E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
C. Studs: Space studs at 16 inches on center (at 406 mm on center).
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
E. Blocking: Install wood blocking for support of:
   1. Wall-mounted cabinets.
   2. Plumbing fixtures.
   3. Toilet partitions.
   4. Toilet accessories.
   5. Wall-mounted door hardware.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.4 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
C. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
    1. Seal joints, cut edges, and holes with water-resistant sealant.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
    1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
B. Corner Beads: Install at external corners, using longest practical lengths.
C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.6 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
    1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
    2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
    3. Level 3: Walls to receive textured wall finish.
    4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
    5. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
    1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
    2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
    3. Taping, filling, and sanding are not required at base layer of double-layer applications.
E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.7 TREATMENT OF “COATED GLASS MAT WATER-RESISTANT GYPSUM BACKING PANELS”

A. Finishing of all joints and entire exposed surface of “coated glass mat water-resistant gypsum backing panels” at surfaces not covered by tile:
    1. Skim coat entire surface of interior coated fiberglass mat faced gypsum backing panels as recommended by board manufacturer. Surface shall be smooth, and free of tool marks, ridges, and fiberglass fiber texture. Skim coat shall be equal to a Level 5 finish for untextured surfaces. Surfaces with light textures may be equal to a Level 4 finish. Finish

Levels shall be according to the latest edition of Gypsum Association publication GA-214 "Recommended Levels of Gypsum Board Finish."

3.8 FINISHING AND PAINTING OF GYPSUM BOARD (DRYWALL) PARTITIONS AND WALLS

A. Refer also to Section 09 91 23 - Interior Painting.

B. A properly painted gypsum board surface is accomplished over a properly prepared gypsum board level of finish compliant with ASTM C840 and GA-610. The properly painted surface includes the compliant finish of the gypsum board. For the purposes of the work of this project the satisfactory finished gypsum board wall, including painting, shall defined similarly to the PDCA - Standard P1, item 2.3 (2007 Edition), as follows.

1. The satisfactory and acceptable wall/partition shall be one that is "uniform in appearance, color, texture, hiding and sheen. It is also free of foreign material, lumps, skins, runs, sags, holidays, misses, or insufficient coverage. It is also a surface free of drips, spatters, spills or overspray caused by the" drywall finish contractor's workforce and "the painting and decorating contractor's workforce."
2. "In order to determine whether a surface has been properly finished and "properly painted" it shall be examined without magnification at a distance of thirty-nine (39) inches or one (1) meter, or more, under finished lighting conditions and from a normal viewing position."

3.9 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tile for floor applications.
B. Tile for wall applications.
C. Non-ceramic trim.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections below is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017.
B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.
C. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement 1999 (Reaffirmed 2016).
D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship 2019.
E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive 2009 (Revised).

F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).
G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy 1999 (Reaffirmed 2010).
H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2010).
I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2010).
J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017.
K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).
M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2016).
N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar 2020.
O. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2012 (Revised).
P. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation 2010 (Reaffirmed 2016).
Q. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation 2014.
R. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2019.
S. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials 2017.
T. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products 2018.
U. TAS - 2012 Texas Accessibility Standards (TAS) 2012.
V. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2019.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
D. Installer's Qualification Statement:
E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Tile: 10 square feet (1 square meters) of each size, color, and surface finish combination.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
B. Installer Qualifications:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.
C. This project shall comply with TAS.
   1. TAS covers scoping and technical requirements for accessibility to sites, facilities, buildings, and elements by individuals with disabilities in the state of Texas.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.9 FIELD CONDITIONS

1.10 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 TILE

A. Manufacturers: All products of each type by the same manufacturer.
   1. Dal-Tile Corporation: www.daltile.com/#sle.

2. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
    a. See article in PART 1 above entitled "Available Manufacturers".

B. Ceramic Mosaic Tile, Type **FT-1**: ANSI A137.1 standard grade.
1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
2. Size: 2 by 2 inch (51 by 51 mm), nominal.
3. Shape: Square.
4. Surface Finish: Unglazed.
5. Color(s): As indicated on drawings.
6. Basis of Design Product:
    a. Dal-Tile Corporation; Keystone Mosaic: www.daltile.com/#sle.

C. Glazed Wall Tile, Types **WT-1**, **-2**, and **-3**: ANSI A137.1 standard grade.
1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
2. Size: 3 by 6 inch (76 by 152 mm), nominal.
3. Edges: Cushioned.
4. Surface Finish: High gloss.
5. Color(s): As indicated on drawings.
6. Trim Units: Matching cove shapes in sizes coordinated with field tile.
7. Basis of Design Product:
    a. Dal-Tile Corporation; Color Wheel Classic: www.daltile.com/#sle.

D. Porcelain Tile, Type **FT-2**: ANSI A137.1 standard grade.
1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
2. Size: 12 by 12 inch (305 by 305 mm), nominal.
3. Thickness: 5/16 inch (8 mm).
4. Edges: Square.
5. Surface Finish: Unglazed.
6. Dynamic Coefficient of Friction, Wet: 0.42 minimum when tested in accordance with ANSI A137.1 / ANSI A326.3 .
7. Color(s): As indicated on drawings.
8. Trim Units, Type **TB-1**: Matching bullnose shapes in sizes coordinated with field tile.
9. Products:
    a. Dal-Tile Corporation; Reminiscent: www.daltile.com/#sle.

2.2 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
1. Applications:
    a. Open edges of wall tile.
    b. Open edges of floor tile.
    c. Wall corners, outside and inside.
    d. Floor to wall joints.
    e. Borders and other trim as indicated on drawings.
2. Manufacturers:
    a. Schluter-Systems: www.schluter.com/#sle.

b. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
   1) See article in PART 1 above entitled "Available Manufacturers".

2.3 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.
B. Manufacturers:
   1. ARDEX Engineered Cements: www.ardexamericas.com.
   2. Bostik Inc: www.bostik-us.com.
   3. Custom Building Products: www.custombuildingproducts.com.
   4. Laticrete International, Inc: www.laticrete.com.
   5. MAPEI Corporation: www.mapei.com/US-EN/.
   6. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".
C. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
   1. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.

2.4 GROUTS

A. Provide setting and grout materials from same manufacturer.
B. Manufacturers:
   1. ARDEX Engineered Cements: www.ardexamericas.com.
   2. Bostik Inc: www.bostik-us.com.
   3. Custom Building Products: www.custombuildingproducts.com.
   4. LATICRETE International, Inc: www.laticrete.com/#sle.
   5. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".
C. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
   1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
   2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
   3. Color(s): As selected by Architect from manufacturer's full line.

2.5 Maintenance Materials

A. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
   1. Composition: Water-based colorless silicone.

2.6 ACCESSORY MATERIALS

A. Waterproofing Membrane at showers: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
   1. Fluid or Trowel Applied Type:

a. Material: Synthetic rubber.
b. Thickness: 25 mils (0.6 mm), minimum, dry film thickness.
c. Products:
    1) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
    2) Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
    1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Protect surrounding work from damage.
B. Vacuum clean surfaces and damp clean.
C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19 , manufacturer's instructions, and TCNA (HB) recommendations.
B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
E. Form internal angles square and external angles bullnosed.
F. Install non-ceramic trim in accordance with manufacturer's instructions.
G. Sound tile after setting. Replace hollow sounding units.
H. Keep control and expansion joints free of mortar, grout, and adhesive.
I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

J. Grout tile joints unless otherwise indicated.
K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
   1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.

3.5 INSTALLATION - SHOWERS AND BATHTUB WALLS

A. At tiled shower receptors install in accordance with TCNA (HB) Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
B. Grout with standard grout as specified above.

3.6 INSTALLATION - WALL TILE

A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

3.7 CLEANING

A. Clean tile and grout surfaces.

3.8 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.
B. Acoustical units.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections (below in this "RELATED REQUIREMENTS" article) is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
C. Division 21 Sections: Sprinkler heads in ceiling system.
D. Division 23 Sections: Air diffusion devices in ceiling.
E. Division 26 Sections: Light fixtures in ceiling system.
F. Divsion 28 Sections: Fire alarm components in ceiling system.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2017.
C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2013.
D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2020.

E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2019.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
B. Do not install acoustical units until after interior wet work is dry.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate grid layout and related dimensioning.
C. Product Data: Provide data on suspension system components and acoustical units.
D. Samples: Submit two samples 4 by 4 inch (100 by 100 mm) in size illustrating material and finish of acoustical units.
E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
F. Manufacturer's Qualification Statement.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 60 00 - Product Requirements, for additional provisions.
    2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.7 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.9 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. USG Corporation: www.usg.com/ceilings/#sle.
   4. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

B. Suspension Systems:
   1. Same as for acoustical units.

2.2 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. VOC Content: As specified in Section 01 61 16.

B. Acoustical Panels: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type III.
      a. Form: 2, water felted.
      b. Pattern: "C" - perforated, small holes.
   2. Size: 24 by 24 inches (610 by 610 mm).
   3. Thickness: 3/4 inch (19 mm).
   4. Light Reflectance: 85 percent, determined in accordance with ASTM E1264.
   5. NRC Range: 0.70 to 0.75, determined in accordance with ASTM E1264.
   6. Panel Edge: Tegular.
   7. Color: White.
   8. Suspension System: Exposed grid.

2.3 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   1. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System: Hot-dipped galvanized steel grid with aluminum cap.
   1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 15/16 inch (24 mm) face width.
   3. Finish: Baked enamel.
   4. Color: White.

2.4 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
C. Hold-Down Clips: Manufacturer's standard clips to suit application.
D. Light fixture securement:
    1. Extra hanging wires: Provide four hanging wires at all locations of light fixtures within grid for hanging of light fixtures by light fixture installer. Locate one wire at each corner of each light fixture.
    2. Provide Hold-down clip near each corner of light fixtures to secure fixture to suspension system grid.
    3. Refer also to Division 26 Sections for additional requirements.
E. Perimeter Moldings: Same metal and finish as grid.
    1. Size: As required for installation conditions.
    2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that layout of hangers will not interfere with other work.

3.2 Preparation

A. Install after major above-ceiling work is complete.
B. Coordinate the location of hangers with other work.

3.3 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM C636/C636M, and ASTM C636/C636M and as supplemented in this section.
B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
C. Locate system on room axis according to reflected plan.
D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
    1. Use longest practical lengths.
E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
H. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
I. Do not eccentrically load system or induce rotation of runners.
J. Prep for interior light fixture:

1. Install extra hanging wires for light fixtures. One wire for each corner of each light fixture. Four wires typically for each fixture. Provide more wires where necessary.
2. Provide hold-down clips, one for each corner of light fixtures.
3. Refer also to Division 26 Sections.

3.4 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.
B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
C. Fit border trim neatly against abutting surfaces.
D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
E. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.
   2. Double cut and field paint exposed reveal edges.
F. Where round obstructions occur, provide preformed closures to match perimeter molding.
G. Lay acoustical insulation for a distance of 48 inches (1219 mm) either side of acoustical partitions as indicated.
H. Install hold-down clips on panels within 20 ft (6 m) of an exterior door.

3.5 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient luxury tile flooring.
B. Resilient base.
C. Installation accessories.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
C. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile 2020.
C. TAS - 2012 Texas Accessibility Standards (TAS) 2012.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

D. Verification Samples: Submit two samples, minimum 6 x 6 inch (150 x 150 mm) in size illustrating color and pattern for each resilient flooring product specified.
E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
G. Manufacturer's Qualification Statement.
H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 60 00 - Product Requirements, for additional provisions.
    2. Extra Flooring Material: Minimum 5% of the number of square feet of each type and color, Complete unopened manufacturers packaging. No partial packages.
    3. Extra Wall Base: Minimum 5% of the number of lineal feet of each type and color, Complete unopened manufacturers packaging. No partial packages.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
D. Protect roll materials from damage by storing on end.
E. Do not double stack pallets.

1.8 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

1.9 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s)

including specified options and additional features.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 TILE FLOORING

A. Vinyl Tile, Type **LVT-1**: Printed film type, with transparent or translucent wear layer.
   1. Manufacturers:
      a. Shaw Contract; Solitude 0648V: www.shawcontract.com.
      b. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
         1) See article in PART 1 above entitled "Available Manufacturers".
   2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
   3. Plank Tile Size: 6 by 48 inch (152 by 1219 mm).
   4. Wear Layer Thickness: 0.020 inch (0.50 mm).
   5. Total Thickness: 3/16 inch (5 mm).
   6. Color: As indicated on drawings.

2.2 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Manufacturers:
      a. Burke Flooring: www.burkeflooring.com/#sle.
      b. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
      c. Roppe Corp: www.roppe.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Height: 4 inch (100 mm).
   3. Finish: Satin.
   4. Length: Roll.
   5. Color: As indicated on drawings.
   6. Accessories: Premolded external corners and internal corners.

2.3 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
   1. VOC Content Limits: As specified in Section 01 61 16.
C. Moldings, Transition and Edge Strips: Rubber.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
    1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.2 PREPARATION

A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
B. Prohibit traffic until filler is fully cured.
C. Clean substrate.

3.3 Installation - General

A. Starting installation constitutes acceptance of subfloor conditions.
B. Install in accordance with manufacturer's written instructions.
C. Adhesive-Applied Installation:
    1. Spread only enough adhesive to permit installation of materials before initial set.
    2. Fit joints and butt seams tightly.
    3. Set flooring in place, press with heavy roller to attain full adhesion.
D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
    1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
    2. Resilient Strips: Attach to substrate using adhesive.
F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.4 Installation - Tile Flooring

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
B. Install plank tile with a random offset of at least 6 inches (152 mm) from adjacent rows.

3.5 Installation - Resilient Base

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
C. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.6 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.
B. Clean in accordance with manufacturer's written instructions.

3.7 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 91 13

EXTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, zinc, and lead.
   6. Floors, unless specifically indicated.
   7. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
   8. Glass.
   9. Concealed pipes, ducts, and conduits.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, **all** documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

C. Section 05 50 00 - Metal Fabrications: Shop-primed items.
D. Section 09 91 23 - Interior Painting.

1.4 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.5 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2016.
B. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test 2020.
C. PDCA Industry Standards - Painting and Decorating Contractors of America - PDCA Industry Standards Current Edition.
D. PDCA Standard P1 - Touch-Up Painting and Damage Repair: Financial Responsibility and Definition of a Properly Painted Surface (Painting and Decorating Contractors of America) 2013.
E. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
F. SSPC-SP 2 - Hand Tool Cleaning 2018.
G. SSPC-SP 13 - Surface Preparation of Concrete 1997 (Reaffirmed 2003).

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
    1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
    2. Product characteristics by manufacturers printed data: **(NOTE: The following list contains intentional BLANKS since it is only an <u>example</u> of data required for product evaluation.)**
        a. Vehicle Type: [____]
        b. Finish: [____].
        c. Minimum Film Thickness per coat in mils: [____] mils Wet (WFT); [____] mils Dry (DFT)
        d. Minimum Volume Solids: [____] %
        e. Pencil Hardness per ASTM D3363: [____].
        f. VOC (less exempt solvents): [_____] lb/gal ([_____] g/l).
            1) Exempt Solvent(s): [____].
        g. HAP (Hazardous Air Pollutants): [_____] lbs/gal ([_____] kg/l) of solids.
        h. Other redeeming feature(s):
            1) [____].
    3. PDS - Product Data Sheet.
    4. SDS - Safety Data Sheet.
    5. EDS - Environmental Data Sheet.
    6. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
    7. Manufacturer's installation instructions.
C. Manufacturer's Instructions: Indicate special surface preparation procedures.

D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: Unopened 1 gallon (4 L) of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five (5) years experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.9 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
D. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

1.10 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

B. Paints:
   1. Base Manufacturer: Sherwin-Williams Company (SW or S-W); www.sherwin-williams.com.
   2. Behr Process Corporation, (Be) : www.behr.com/#sle.
   3. Coronado Paints (CP), manufactured by Benjamin Moore & Co.: www.coronadopaint.com.
   4. PPG Paints, (PPG): www.ppgpaints.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 2500 - Substitution Procedures.
   1. See article in PART 1 above entitled "Available Manufacturers".

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. The preparation, application, finish (and inspection) work consistent with the PDCA Industry Standards shall be followed. The work of this project shall include a properly painted/stained/coated surface. This shall include the substrate, substrate preparation, manufacturer recommended environmental conditions, recommended primer/sealer and finish coatings applications, protection of finishes and touch-up of damaged coatings after substantial completion.
   1. A “properly painted/stained/coated surface” for the Work of this project is defined by PDCA Standard P1 as "uniform in appearance, color, texture, hiding and sheen. It is also free of foreign material, lumps, skins, runs, sags, holidays, misses, or insufficient coverage. It is also a surface free of drips, spatters, spills or overspray caused by the painting and decorating contractor’s work force or similar and additional damage caused by others prior to completion of this project.”
   2. Per PDCA Standard P1, in order to determine whether a surface has been “properly painted/stained/coated” it shall be examined without magnification at a distance of thirty-nine (39) inches or one (1) meter, or more, under finished lighting conditions and from a normal viewing position.

3. The Architect and/or Owner shall determine the adequacy and acceptance of the work.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

2.3 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete and concrete masonry units.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Exterior Latex.
      a. Products:
         1) Sherwin-Williams Loxon XP Exterior.
         2) Substitutions: Section 01 60 00 - Product Requirements.

B. Paint E-OP-HD-DT Heavy Duty Door/Trim: For surfaces subject to frequent contact by occupants, including steel and galvanized steel:
   1. Heavy duty applications include doors, door frames, railings, and other metal items and surfaces indicated to be painted.
   2. Two top coats and one coat primer.
   3. Top Coats: Two (2) coats premium quality interior/exterior enamel formulated with a urethane modified alkyd resin system. Product: Sherwin Williams (SW) Pro Industrial Waterbased Alkyd Urethane Enamel, Semi-Gloss B53-1150 Series.
      a. Vehicle Type: Urethane modified alkyd.
      b. Finish: Semi-Gloss.
      c. Pencil Hardness per ASTM D3363: 5H.
   4. Primer: As recommended by top coat manufacturer for specific substrate. Verify compatibility.
      a. Provide primer over existing coated & uncoated surfaces, including shop primed coatings.
      b. Primers over existing coated & uncoated surfaces surfaces, including shop primed coatings, shall be tested and verified to be appropriate for compatibility and bridging of existing surfaces to new top coating.

2.4 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
C. Test shop-applied primer for compatibility with subsequent cover materials.
D. Primers over existing coated & uncoated surfaces, including shop primed coatings, shall be tested and verified to be appropriate for compatibility and bridging of new or existing surfaces to new top coating.
E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
    1. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
D. Seal surfaces that might cause bleed through or staining of topcoat.
E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
F. Concrete:
    1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
    2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi (10,350 to 27,580 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.
    3. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
G. Masonry:
    1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
    2. Prepare surface as recommended by top coat manufacturer.
    3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi (4,140 to 10,350 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.
H. Galvanized Surfaces:
    1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
    2. Prepare surface according to SSPC-SP 2.
I. Ferrous Metal:
    1. Solvent clean according to SSPC-SP 1.
    2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's written instructions.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
C. Apply each coat to uniform appearance.
D. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

3.6 COLOR SCHEDULE

A. Refer to the drawings.

END OF SECTION

SECTION 09 91 23

INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
    1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
    2. Mechanical and Electrical:
        a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
D. Do Not Paint or Finish the Following Items:
    1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
    2. Items indicated to receive other finishes.
    3. Items indicated to remain unfinished.
    4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
    5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
    6. Marble, granite, slate, and other natural stones.
    7. Floors, unless specifically indicated.
    8. Ceramic and other tiles.
    9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
    10. Glass.
    11. Acoustical materials, unless specifically indicated.
    12. Concealed pipes, ducts, and conduits.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
    1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
    2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections (below in this "RELATED REQUIREMENTS" article) is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
C. Section 05 50 00 - Metal Fabrications: Shop-primed items.

1.4 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.5 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2016.
B. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test 2020.
C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.
D. PDCA Industry Standards - Painting and Decorating Contractors of America - PDCA Industry Standards Current Edition.
E. PDCA Standard P1 - Touch-Up Painting and Damage Repair: Financial Responsibility and Definition of a Properly Painted Surface (Painting and Decorating Contractors of America) 2013.
F. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
G. SSPC-SP 2 - Hand Tool Cleaning 2018.
H. SSPC-SP 13 - Surface Preparation of Concrete 1997 (Reaffirmed 2003).

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
    1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
    2. Product characteristics by manufacturers printed data: (NOTE: The following list contains INTENTIONAL BLANKS since it is only an example of data required for product evaluation. This information must be provided for Submittals and/or Substitution Requests reviews.)
        a. Vehicle Type: [_____]
        b. Finish: [_____].
        c. Minimum Film Thickness per coat in mils: [___] mils Wet (WFT); [___] mils Dry (DFT)
        d. Minimum Volume Solids: [___] %
        e. Pencil Hardness per ASTM D3363: [_____].

f. VOC (less exempt solvents): [_____] lb/gal ([_____] g/l).
   1) Exempt Solvent(s): [_____].
g. HAP (Hazardous Air Pollutants): [_____] lbs/gal ([_____] kg/l) of solids.
h. Other redeeming feature(s):
   1) [_____].

3. PDS - Product Data Sheet.
4. SDS - Safety Data Sheet.
5. EDS - Environmental Data Sheet.
6. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
7. Manufacturer's instructions for surface preparation and application.
8. Primers over existing coated & uncoated surfaces surfaces, including shop primed coatings, shall be tested and verified to be appropriate for compatibility and bridging of new or existing surfaces to new top coating.

C. Manufacturer's Instructions: Indicate special surface preparation procedures.
D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: Unopened 1 gallon (4 L) of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five (5) years experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.9 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces.
D. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

1.10 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
B. Paints:
   1. Base Manufacturer: Sherwin-Williams Company; www.sherwin-williams.com.
   2. Behr Process Corporation: www.behr.com/#sle.
   3. Coronado Paints, manufactured by Benjamin Moore & Co.: www.coronadopaint.com.
   4. PPG Paints: www.ppgpaints.com/#sle.
   5. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
C. Substitutions: See Section 01 2500 - Substitution Procedures.
   1. See article in PART 1 above entitled "Available Manufacturers".

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
B. The preparation, application, finish (and inspection) work consistent with the PDCA Industry Standards shall be followed. The work of this project shall include a properly

painted/stained/coated surface. This shall include the substrate, substrate preparation, manufacturer recommended environmental conditions, recommended primer/sealer and finish coatings applications, protection of finishes and touch-up of damaged coatings after substantial completion.

1. A “properly painted/stained/coated surface” for the Work of this project is defined by PDCA Standard P1 as "uniform in appearance, color, texture, hiding and sheen. It is also free of foreign material, lumps, skins, runs, sags, holidays, misses, or insufficient coverage. It is also a surface free of drips, spatters, spills or overspray caused by the painting and decorating contractor’s work force or similar and additional damage caused by others prior to completion of this project.”
2. Per PDCA Standard P1, in order to determine whether a surface has been “properly painted/stained/coated” it shall be examined without magnification at a distance of thirty-nine (39) inches or one (1) meter, or more, under finished lighting conditions and from a normal viewing position.
3. The Architect and/or Owner shall determine the adequacy and acceptance of the work.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

2.3 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete masonry units, and wood.
   1. Two top coats and one coat primer.
   2. Top Coat(s): High Performance Architectural Interior Latex.
      a. Products:
         1) Sherwin-Williams ProMar 200 HP Series, Low Gloss Eg-Shel.
         2) Substitutions: Section 01 60 00 - Product Requirements.

B. Paint I-OP-HD-DT - Heavy Duty Door/Trim: For surfaces subject to frequent contact by occupants, including steel and galvanized steel:
   1. Heavy duty applications include doors, door frames, railings, and other metal items and surfaces indicated to be painted.
   2. Two top coats and one coat primer.
   3. Top Coats: Two (2) coats premium quality interior/exterior enamel formulated with a urethane modified alkyd resin system. Product: Sherwin Williams (SW) Pro Industrial Waterbased Alkyd Urethane Enamel, Semi-Gloss B53-1150 Series.
      a. Vehicle Type: Urethane modified alkyd.
      b. Finish: Semi-Gloss.
      c. Pencil Hardness per ASTM D3363: 5H.
   4. Primer: As recommended by top coat manufacturer for specific substrate. Verify compatibility.
      a. Provide primer over existing coated & uncoated surfaces, including shop primed coatings.
      b. Primers over existing coated & uncoated surfaces surfaces, including shop primed coatings, shall be tested and verified to be appropriate for compatibility and bridging of

existing surfaces to new top coating.

C. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
   1. Shop primer by others.
   2. One top coat As selected by architect.
   3. Top Coat: Latex Dry Fall.
      a. Products:
         1) Sherwin-Williams Waterborne Acrylic Dryfall, Flat.
         2) Substitutions: Section 01 60 00 - Product Requirements.
   4. Primer: As recommended by top coat manufacturer for specific substrate.

D. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat, at plywood wall surfaces:
   1. One coat of latex primer sealer. Sherwin Williams Exterior Wood Primer as recommended by top coat manufacturer.
   2. Eggshell: Two coats of latex; Sherwin Williams Pro Industrial Acrylic B66-660 Series, Eg-Shel.

2.4 PRIMERS

A. Where primer is not specified provide as recommended by top coat manufacturer for specific substrate.
B. Provide primer over existing coated & uncoated surfaces, including shop primed coatings.
   1. Primers shall be tested and verified to be appropriate for compatibility and bridging of new or existing surfaces to new top coating.

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
B. Patching Material: Latex filler.
C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
C. Test shop-applied primer for compatibility with subsequent cover materials.
D. Provide primer over existing coated & uncoated surfaces, including shop primed coatings.
   1. Primers shall be tested and verified to be appropriate for compatibility and bridging of new or existing surfaces to new top coating.
E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or repair existing paints or finishes that exhibit surface defects.
D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
E. Seal surfaces that might cause bleed through or staining of topcoat.
F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
G. Concrete:
    1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
    2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi (10,350 to 27,580 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.
    3. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
I. Galvanized Surfaces:
    1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
    2. Prepare surface according to SSPC-SP 2.
J. Ferrous Metal:
    1. Solvent clean according to SSPC-SP 1.
    2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
K. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
L. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
M. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
B. Apply products in accordance with manufacturer's written instructions.
C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
E. Sand wood and metal surfaces lightly between coats to achieve required finish.
F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.
B. Owner will provide field inspection.

3.5 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.6 PROTECTION

A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 11 00

VISUAL DISPLAY UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Markerboards
B. Tackboards

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. ANSI A135.4 - Basic Hardboard 2012 (R2020).
C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling 2018.
D. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board 2012, with Editorial Revision (2019).
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
F. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics 2015.
G. TAS - 2012 Texas Accessibility Standards (TAS) 2012.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data on markerboard, tackboard, tackboard surface covering, trim, and accessories.
C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
D. Samples: Submit color charts for selection of color and texture of markerboard, tackboard, tackboard surface covering, and trim.
E. Samples: Submit two samples 2 by 2 inch (50 by 50 mm) in size illustrating materials and finish, color and texture of markerboard, tackboard, tackboard surfacing, and trim.
F. Test Reports: Show compliance to specified surface burning characteristics requirements.
G. Manufacturer's printed installation instructions.
H. Manufacturer's Qualification Statement.
I. Maintenance Data: Include data on regular cleaning, stain removal .

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.
B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning and staining.

1.8 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Claridge Products and Equipment, Inc: www.claridgeproducts.com/#sle.
B. Nelson Adams NACO: www.nelsonadamsnaco.com/#sle.
C. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
    1. See article in PART 1 above entitled "Available Manufacturers".

2.2 VISUAL DISPLAY UNITS

A. Markerboards: Porcelain enamel on steel, laminated to core.
   1. Color: White.
   2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch (0.61 mm).
   3. Core: Fiberboard, manufacturer's standard thickness, laminated to face sheet.
   4. Backing: Aluminum foil, laminated to core.
   5. Size: As indicated on drawings.
   6. Length: As indicated on drawings.
   7. Frame: Extruded aluminum , with concealed fasteners.
   8. Frame Finish: Anodized, natural.
   9. Accessories: Provide marker tray and map rail.

B. Tackboards: Fine-grained, homogeneous natural cork.
   1. Cork Thickness: 1/8 inch (3 mm).
   2. Fabric: Vinyl coated fabric.
   3. Color: As selected from manufacturer's full range.
   4. Backing: Hardboard, 1/4 inch (6 mm) thick, laminated to tack surface.
   5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
   6. Size: As indicated on drawings.
   7. Length: As indicated on drawings.
   8. Frame: Same type and finish as for markerboard.
   9. Accessories: Provide map rail.

C. Combination Units and Units Made of More Than One Panel: Factory-assembled markerboards and tackboards in a single frame, of materials specified above.
   1. Join panels of different construction with H-shaped extruded aluminum molding finished to match frame.
   2. Configuration: As indicated on drawings.
   3. Units Too Large to Ship Assembled: Fully assembled in factory, then disassembled for shipping.

2.3 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
B. Vinyl Coated Fabric: ASTM F793 Category VI.
C. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).
D. Fiber Board: ASTM C208, cellulosic fiber board.
E. Foil Backing: Aluminum foil sheet, 0.005 inch thick (0.13 mm thick).
F. Adhesives: Type used by manufacturer.

2.4 ACCESSORIES

A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall (; 25 mm wide overall) , full width of frame.
B. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
C. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.2 PREPARATION

A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.
B. Install with top of marker tray at 30 inches (760 mm) above finished floor.
C. Secure units level and plumb.

3.4 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.
B. Cover with protective cover, taped to frame.
C. Remove temporary protective cover at Date of Substantial Completion.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Room and door signs.
B. Building identification signs.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the related documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 09 21 16 - Gypsum Board Assemblies: Substrate.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
D. TAS - 2012 Texas Accessibility Standards (TAS) 2012.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.

1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
3. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
F. Verification Samples: Submit samples showing colors specified.
G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.
B. Package room and door signs in sequential order of installation, labeled by floor or building.
C. Store tape adhesive at normal room temperature.

1.8 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain this minimum temperature during and after installation of signs.

1.9 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flat Signs:
   1. APCO Signs; www.apcosigns.com.

2. Best Sign Systems, Inc: www.bestsigns.com/#sle.
3. Cosco Industries (ADA signs): www.coscoarchitecturalsigns.com/#sle.
4. Mohawk Sign Systems, Inc: www.mohawksign.com/#sle.
5. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
    a. See article in PART 1 above entitled "Available Manufacturers".

B. Dimensional Letter Signs:
1. A.R.K. Ramos Architectural Signage Systems: www.arkramos.com/#sle.
2. APCO Signs; www.apcosigns.com.
3. Gemini: www.geminisignproducts.com.
4. The Southwell Company: www.southwellco.com
5. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
    a. See article in PART 1 above entitled "Available Manufacturers".

2.2 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with TAS, ADA Standards, and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
1. Sign Type: Flat signs with applied character panel media as specified.
2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
3. Character Height: 1 inch (25 mm).
4. Sign Height: As indicated on the drawings.
5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings.
6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings.
7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

C. Building Identification Signs:
1. Use individual metal letters.
2. Mount on outside wall in location indicated on drawings.

D. Other Dimensional Letter Signs: Wall-mounted.

2.3 TACTILE SIGNAGE MEDIA (interior room and door signs)

A. Flat Signs: Signage media without frame.
1. Edges: Square.
2. Corners: Radiused.
3. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Photopolymer Panel Construction: 1/4 inch (6 mm) acrylic plastic base, with applied 1/2 inch (12 mm) photopolymer plate with raised letters and braille.
   1. Total Thickness: 3/4 inch (19 mm) .
   2. Letter Thickness: 1/16 inch (1.6 mm).
   3. Letter Edges: Square.

C. Color and Font: Unless otherwise indicated:
   1. Character Font: To be determinined during signage review.
   2. Character Case: Upper case only.
   3. Background Color: As scheduled.
   4. Character Color: Contrasting color.

D. ACCESSORIES
   1. Exposed Screws: Painted to match sign.
   2. Tape Adhesive: Double sided tape, permanent adhesive.

2.4 DIMENSIONAL LETTERS AND GRAPHICS

A. Metal Letters and Graphics:
   1. Metal: Aluminum casting.
      a. Characters shall be cast from 319 aluminum. Casting shall be free of pits and gas holes and all letters shall be sharp and hand tooled. Faces of characters shall be satin polished finish with matte sides.
      b. Extruded aluminum characters (except for "Texas Star") are also acceptable.
   2. Letterform Height: As shown on the drawings.
   3. Graphics Height: As shown on the drawings.
      a. "Texas Star" is a dimensional graphic.
   4. Thickness: 1/2 inch (12 mm).
   5. Finish: Satin finish, clear anodized.
   6.

B. ACCESSORIES
   1. Concealed anchors as recommended by manufacturer.
   2. Epoxy cement as recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install neatly, with horizontal edges level.
C. Locate room signs and mount at heights indicated on drawings and in accordance with ADA Standards and TAS.
D. Locate metal letters and mount at heights indicated on drawings.

3.3 INTERFACE WITH OTHER WORK

A. Coordinate letter and graphic locations, anchor locations and sequencing of work of all trades in and around mounting area.

3.4 CLEANING

A. Clean signage, letters, and graphics in accordance with manufacturer's instructions.
B. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 21 13.19

PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Solid plastic toilet compartments.
   1. High density polyethylene (HDPE) material
      a. Material shall comply with ICC IBC 2018 §803.1.1 and §803.1.1.1 per NFPA 286
B. Urinal screens.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 06 10 53 - Miscellaneous Rough Carpentry: Mounting boards, concealed wood blocking, nailers, and supports.
C. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2019.
C. TAS - Texas Accessibility Standards: Required compliance for handicapped accessibility in Texas.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with placement of support framing and anchors in walls.

1.6 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for processing submittals.
B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
C. Product Data: Provide data on panel construction, hardware, and accessories.
   1. Provide fire hazard classification test data showing compliance with NFPA 286.
   2. Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
D. Samples: Submit two samples of partition panels, 4 by 4 inch (100 by 100 mm) in size illustrating panel finish, color, and sheen.
E. Manufacturer's Installation Instructions: Indicate special procedures.

1.7 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Solid Plastic HPDE Toilet Compartments:
   1. Basis of Design: Scranton Products (Santana/Comtec/Capital); Hiney Hiders Solid Plastic HPDE: www.scrantonproducts.com.
   2. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

2.2 PLASTIC TOILET COMPARTMENTS

A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
   1. Color: As determined from manufacturers compliant colors..
B. Performance/ Design Criteria:
   1. Fire hazard classification:
      a. Compliance with ICC IBC per NFPA 286. Classification in accordance with only ASTM E84 or UL 723 is not an acceptable alternative.

C. Doors:
   1. Thickness: 1 inch (25 mm).
   2. Width: 24 inch (610 mm).
   3. Width for Handicapped Use: 36 inch (915 mm), out-swinging.
   4. Height: 55 inch (1397 mm).

D. Panels:
   1. Thickness: 1 inch (25 mm).
   2. Height: 55 inch (1397 mm).
   3. Depth: As indicated on drawings.

E. Pilasters:
   1. Thickness: 1 inch (25 mm).
   2. Width: As required to fit space; minimum 3 inch (76 mm).

F. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.3 ACCESSORIES

A. Pilaster Shoes: Stainless steel, satin finish, 3 inches (76 mm) high; concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Extruded aluminum, anti-grip profile.
   1. Size: Manufacturer's standard size.

C. Wall and Pilaster Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.

D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.

E. Hinges: Stainless steel, manufacturer's standard finish.
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.

F. Door Hardware: Stainless steel, manufacturer's standard finish.
   1. Door Latch: Slide type with exterior emergency access feature.
   2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
   3. Provide door pull for outswinging doors.

G. Coat Hook: One per compartment, mounted on door.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify correct spacing of and between plumbing fixtures.
C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.
C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch (6 mm).
B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.4 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Commercial toilet accessories.
B. Commercial shower and bath accessories.
C. Under-lavatory pipe supply covers.
D. Utility room accessories.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 06 10 53 - Miscellaneous Rough Carpentry: Mounting boards, concealed wood blocking, nailers, and supports.
C. Section 10 21 13.19 - Plastic Toilet Compartments.
D. Section 10 51 13 - Metal Lockers : Bench, type **TA-12**.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures 2011 (Reaffirmed 2017).
C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
E. ASTM C1036 - Standard Specification for Flat Glass 2021.

F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.
G. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping 2021.
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015 (Reapproved 2021)e1.
J. TAS - 2012 Texas Accessibility Standards (TAS) 2012.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
C. Samples: Submit two samples of each accessory, illustrating color and finish.
D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.7 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. American Specialties, Inc: www.americanspecialties.com/#sle.
   2. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
   3. Bradley Corporation: www.bradleycorp.com/#sle.
   4. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

B. Under-Lavatory Pipe Supply Covers:
   1. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
   2. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

C. Provide products of each category type by single manufacturer.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide two keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

E. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.3 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.

2.4 COMMERCIAL TOILET ACCESSORIES

A. Refer to Toilet & Miscellaneous Accessory Schedule on the drawings for product and style.

B. Toilet Paper Dispenser, Type **TA-03**: Roll-in-reserve type, designed to allow automatic activation of reserve roll when needed, surface-mounted, all-welded construction, 18 ga. stainless steel unit with pivot hinge, tumbler lock.

C. Combination Towel Dispenser/Waste Receptacle, Type **TA-05**: Recessed with projecting waste receptacle, 20 ga stainless steel door with heavy gauge stainless steel frame; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
   1. Waste receptacle liner: Reusable, heavy-duty vinyl.
   2. Capacity: 8 inch diameter universal standard core roll.
   3. Paper Discharge: Touchless automatic.
   4. Towel dispenser capacity: 800 ft long.
   5. Minimum waste receptacle capacity: 12 gallons (45 liters).

D. Mirrors, Type **TA-07** and **TA-09**: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: As indicated on the drawings.
   3. Frame: 0.05 inch (1.3 mm)angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   4. Backing: Full-mirror sized, minimum 0.03 inch (0.8 mm) galvanized steel sheet and nonabsorptive filler material.

E. Grab Bars, Types **TA-01**, **-02**, **-15**, and **-16**: Stainless steel, anti-slip resistant surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
      b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, concealed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
      c. Length and Configuration: As indicated on drawings.

F. Sanitary Napkin Disposal Unit, Type **TA-04**: 22 ga. stainless steel, all-welded construction, surface-mounted, self-closing door with full-length stainless steel piano-type hinge.

G. Shelf. Type **TA-17**. Fixed stainless steel type 304, 18 gauge (1.2 mm). 3/4 inch (19 mm) return edges with hemmed front edge. Mounting brackets (2) type-304, 16-gauge (1.6mm) stainless steel. Brackets welded to back return of shelf and secured inside front hem of shelf.
   1. Finish: Satin.
   2. Refer to the Toilet and Miscellaneous Accessory Schedule in the drawings for basis of design product selection and size.
   3. Secure with tamper resistant screws into concealed blocking or other secure substrate.
   4. Substitutions: Section 01 60 00 - Product Requirements.

2.5 Commercial Shower and Bath Accessories

A. Shower Curtain Rod, Type **TA-08**: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 1-3/8 inch (35 mm) outside diameter, chrome-plated flanges, for concealed mounting over aluminum mounting brackets.

B. Shower Curtain, Type **TA-08**:
   1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
   2. Size: 70 by 72 inches (1780 by 1830 mm), hemmed edges.
   3. Grommets: White HDPE; pierced through top hem on 6 inch (150 mm) centers.
   4. Color: White.
   5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.

C. Coat Hook, Type **TA-10**: Heavy-duty stainless steel, double hook welded to support arm, mounting bracket and backplate for concealed attachment, satin finish.

2.6 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:
   1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
   2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
   3. Construction: 1/8 inch (3.2 mm) flexible PVC.
      a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
      b. Comply with ASTM C1822, type indicated.
      c. Comply with ASME A112.18.9.
      d. Microbial and Fungal Resistance: Comply with ASTM G21.

4. Color: White.
5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.

2.7 Utility Room Accessories

A. Mop and Broom Holder, Type **TA-11**: 0.03 inch (0.8 mm) thick stainless steel, Type 304, hat-shaped channel.
   1. Holders: Three spring-loaded rubber cam holders.
   2. Length: 36 inches (900 mm).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify exact location of accessories for installation.
C. Verify that field measurements are as indicated on drawings.
D. See Section 06 10 53 for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.
B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
B. Install plumb and level, securely and rigidly anchored to substrate.
C. Mounting Heights: As required by ADA Standards and TAS regulations, unless otherwise indicated.
   1. Grab Bars: As indicated on drawings.
   2. Other Accessories: As indicated on drawings.

3.4 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers.
B. Accessories.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 06 10 53 - Miscellaneous Rough Carpentry: Mounting boards, concealed wood blocking, nails, and supports.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. FM (AG) - FM Approval Guide current edition.
B. NFPA 10 - Standard for Portable Fire Extinguishers 2017, with Errata (2018).
C. TAS - 2012 Texas Accessibility Standards (TAS) 2012.
D. UL (DIR) - Online Certifications Directory Current Edition.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for processing submittals.
B. Product Data: Provide extinguisher operational features.
C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.6 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

1.7 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fire Extinguishers:
   1. Amerex Corporation, 7595 Gadsden Highway, Trussville, AL 35173: T: (205) 655-3271; F: (800) 654-5980; amerex-fire.com
      a. Product: Amerex model no. B441 (with brass valve)
   2. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

2.2 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10.

B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

2.3 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Dry Chemical Type Fire Extinguishers: Aluminum tank, with pressure gage.
   1. Cartridge Operated: Spun shell.
   2. Stored Pressure Operated: Deep Drawn.
   3. Brass Valve - Heavy Duty.
      a. Chrome plated brass valve body;

b. Stainless steel handle and lever.
4. Class: A:B:C type.
5. Size: 20 pound (9.1 kg).
6. Finish: Baked polyester powder coat, Red color.
7. Temperature range: Minus 65 degrees F (Minus 54 degrees C) to 120 degrees F (49 degrees C).

2.5 FIRE EXTINGUISHER CABINETS

A. Cabinets shall be fire rated cabinets at fire rated walls. Cabinet rating shall be equivalent to the rating of the wall.
B. Cabinet Configuration: Semi-recessed type.
1. Size to accommodate accessories.
2. Trim: Flat, with 1 inch (25 mm) wide face.
C. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.
D. Door Glazing: Tempered glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
1. Full panel glazing.
E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
F. Weld, fill, and grind components smooth.
G. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
H. Finish of Cabinet Interior: White colored enamel.

2.6 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.
B. Cabinet Signage: "Fire Extinguisher" in vertical letters..
C. Wall Signage: "Fire Extinguisher" in vertical letters at extinguishers not contained in cabinets.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install extinguishers plumb and level, with reach to handle compliant with TAS.
C. Secure rigidly in place.

END OF SECTION

SECTION 10 51 13

METAL LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal lockers.
B. Locker benches.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer also to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 03 30 00 - Cast-in-Place Concrete: Concrete base construction.
C. Section 06 10 00 - Rough Carpentry: Wood blocking and nailers.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021.
D. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
E. TAS - 2012 Texas Accessibility Standards (TAS) 2012.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.

C. Shop Drawings: Indicate locker plan layout, numbering plan.
D. Samples: Submit two samples 4 by 4 inches (100 by 100 mm) in size showing color and finish of metal locker material.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

1.7 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Lockers:
   1. ASI Storage Solutions: www.asi-storage.com/#sle.
   2. Lyon Workspace Products: www.lyonworkspace.com/#sle.
   3. Penco Products, Inc: www.pencoproducts.com/#sle.
   4. Republic Storage Systems Co: www.republicstorage.com/#sle.
   5. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

2.2 LOCKER APPLICATIONS

A. Wardrobe Lockers: Metal lockers, free-standing for base indicated on drawings.
   1. Width: 15 inches (381 mm).
   2. Depth: 18 inches (457 mm).
   3. Height: 72 inches (1830 mm).
   4. Configuration: Single tier.
   5. Fittings: Size and configuration as indicated on drawings.
      a. Hat shelf.
      b. Hooks: Two single prong.
   6. Ventilation: Louvers at top and bottom of door panel.
   7. Provide sloped top.

B. Locker Benches, Type **TA-12**: Stationary type; bench top of laminated maple; satin stainless steel rectangular style legs. Provide integrated back at locations where ADA bench is not mounted to wall.
   1. Accessibility: Comply with TAS and ADA Standards.
   2. Height: 18 inch (457 mm).
   3. Length: 42 inch (1067 mm).
   4. Depth: 20 inch (508 mm).
   5. Basis of Design: Hollman; Oslo Bench: hollman.com.

2.3 METAL LOCKERS

A. Accessibility: Comply with TAS, ICC A117.1, and ADA Standards.
B. Locker Case Construction:
   1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
      a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.
      b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
         1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M.
         2) Body and Shelves: 16 gauge, 0.0598 inch (1.52 mm).
         3) Backs: 18 gauge, 0.0478 inch (1.21 mm).
      c. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
         1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.
      d. Where ends or sides are exposed, provide flush panel closures.
      e. Provide filler strips where indicated or required, securely attached to lockers.
C. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
   1. Door Thickness: 16 gauge, 0.0598 inch (1.52 mm), minimum.
   2. Form recess for operating handle and locking device.
D. Latches and Door Handles: Manufacturer's standard.
E. Hinges: Continuous piano hinge with powder coat finish to match locker color.
F. Sloped Top: 20 gauge, 0.0359 inch (0.91 mm), with closed ends.
G. Trim: 20 gauge, 0.0359 inch (0.91 mm).
H. Coat Hooks: Stainless steel or zinc-plated steel.
I. Number Plates: Provide oval shaped aluminum plates. Form numbers 1/2 inch (13 mm) high of block font style with ADA designation, in contrasting color.
J. Locks: Locker manufacturer's standard type indicated in Applications article above.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.
C. Install lockers plumb and square.
D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).
E. Bolt adjoining locker units together to provide rigid installation.
F. Install end panels, filler panels, and sloped tops.
G. Install fittings if not factory installed.
H. Replace components that do not operate smoothly.

3.3 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 10 75 00

FLAGPOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum Flagpoles.
   1. For flying two flags on one pole.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, **all** documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.

B. Section 03 30 00 - Cast-in-Place Concrete: Concrete base and foundation construction.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains 2016.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2020.

C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.

D. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles 2007.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pole, accessories, and configurations.

C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

D. Samples: Submit two aluminum samples, 4 by 4 inch (100 by 100 mm) in size, illustrating pole material, color, and finish.
E. Manufacturer's Qualification Statement.
F. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules and written instructions for both operating and maintenance procedures.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed TEXAS.
B. Flagpoles shall be manufactured within the United States ("American Made").

1.7 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flagpoles:
    1. Concord American Flagpole: www.concordamericanflagpole.com
    2. Pole-Tech Co, Inc: www.poletech.com/#sle.
    3. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001
    1. Material: Aluminum.
    2. Design: Cone tapered.
    3. Mounting: Ground mounted type.
    4. Outside Butt Diameter: 6 inches (152 mm).
    5. Outside Tip Diameter: 3.5 inches (89 mm).
    6. Nominal Wall Thickness: 0.156 inches (3.96 mm).
    7. Nominal Height: 30 ft (9.14 m); measured from nominal ground elevation.
    8. Halyard: Interior type .
B. Performance Requirements:
    1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 105 miles/hr (169 km/hr) wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.3 POLE MATERIALS

A. Aluminum: ASTM B221 (ASTM B 221M) , 6063 alloy , T6 temper.

2.4 ACCESSORIES

A. Finial Ball: Aluminum, 6 inch (150 mm) diameter, gold anodized finish.
B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
C. Halyard: 5/16 inch (8 mm) diameter stainless steel aircraft cable.
D. Snap Hooks for attaching two flags.

2.5 OPERATORS

A. Hand Crank: Removable crank type.

2.6 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gauge, 0.0598 inch (1.52 mm) steel, galvanized, depth as indicated on the structural shop drawings.
B. Pole Base Attachment: Flush; aluminum base with base cover.
C. Lightning Ground Cable: Copper No. 6 AWG, soft drawn.

2.7 FINISHING

A. Metal Surfaces in Contact With Concrete: Asphaltic paint.
B. Aluminum: Mill finish.
C. Finial: Spun finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.2 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.3 INSTALLATION

A. Install flagpole , base assembly, and fittings in accordance with manufacturer's written instructions and approved shop drawings.
B. Fill foundation tube sleeve with concrete specified in Section 03 30 00.
C. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1 inch (25 mm).

3.5 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 10 81 13

BIRD NET

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes Bird Net fabric and installation, complete.

B. All work and materials must conform to applicable performance standards where referenced in the specifications.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.

1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Related documents are:

1. All documents contained in the Contract Documents, information provided in Section 00 3100 - Available Project Information, and Owner provided information, including but not limited to:
   a. Drawings: All drawings.
   b. Specifications: Active Divisions 00 through 49.
      1) The *CSI MasterFormat* 2016 Edition identifies "active" Divisions and the Divisions "Reserved for Future Expansion". The Divisions "Reserved for Future Expansion" shall not be used in this project.
   c. The agreement or contract between the Owner and the Contractor (“Construction Contract”).
   d. General Conditions of the contract.
   e. Supplementary Conditions of the contract.
   f. Special Conditions.
   g. Additional Supplementary Conditions of the contract.
   h. Bid documents.
   i. Geotechnical report.
2. Codes, regulations, and statutes applying to the Work of this section, including Local, State, and Federal codes, regulations, and statutes.
3. This project shall comply with the 2012 TAS and the 2010 ADA Standards and other relevant accessibility regulations, related documents and Authorities Having Jurisdiction (AHJ's) at applicable locations.
4. Industry-related documents applying to selection, preparation, and installation of materials and systems generally accepted in the industry for work under this Section, and including

the documents listed herein.

5. The construction schedule prepared by the Contractor and provided to the Owner and Architect. All work under this Section shall be priced, bid, planned, coordinated, procured, and installed in accordance with the construction schedule.

C. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 13 34 19 - Metal Building Systems:

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings showing awnings in elevation, plan and section. Drawings shall include the following details:
   1. All frame dimensions including overall fabric panel dimensions.
   2. Frame module labels.
   3. Frame module connection details.
   4. Connection details.
   5. Material information.
   6. All other applicable information.
C. Samples: Furnish 12” x 12” of fabric with indicated color & finish.
D. Include engineering calculations showing wind load calculations when required by the building codes.

1.5 QUALITY ASSURANCE:

A. Manufacturer to have greater than 10 years’ experience.
B. The personnel manufacturing the metal awning frames must be certified welders.

1.6 WARRANTY:

A. Bird-X Net System including installation shall be warranted for five years. Hardware and fabric attachment shall be warranted against defective material and workmanship for a period of five years by manufacturer. Fabrics shall be warranted by the fabric manufacturer for a minimum of five years. Labor to replace defective fabric shall be guaranteed for two years.

1.7 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect.

Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.

1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.

B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Bird-X Inc.: www.bird-x.com
   1. Product: Bird-X HDPE Fabric Bird Net.
B. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
   1. See article in PART 1 above entitled "Available Manufacturers".

2.2 MATERIALS:

A. Fabric
   1. Chemical Properties:
      a. High Density Polyethylene (HIIPE). Chemically inert. Will not absorb water.
      b. High-density polyethylene (HDPE).
   2. Electrical Properties - Non-conductive.
   3. UV Stability: UV protection system of Hindered Amine Light Stabilizers
   4. Thermal Properties: Melting point in excess of 250 degrees F. Flame resistant. Can be heated for short periods of time in excess of 500 degrees F.
   5. Construction: 12/6 construction - 6 strands of UV protected HDPE yarn, each 0.012 inch in diameter.
   6. Break Strength: 52 lbs. per strand.
   7. ISO 1806 Mesh Strength Test: Peak Load 35"32 lbs of force.
   8. 24 Inch Wide Span Orthogonal Strength Test: Peak Load 575 lbs force

PART 3 EXECUTION

3.1 SUBSTRATE PREPARATION:

A. Net system fabricator shall furnish General Contractor with template of proposed mounting points. General Contractor shall install solid blocking, 2x stock minimum at each mounting point.

3.2 FABRIC APPLICATION:

A. Fabric is to be applied tight and is to be free of wrinkles, sagging, puckers, and punctures. All panels are to be equal in tension and quality.

3.3 INSTALLATION:

A. Installations shall be structurally sound, level and leak free. Net to have no blemishes and is to meet local codes.

B. Fasteners are to be appropriate for the mounting substrate.
C. Fasteners shall be set with compression sleeves inserted into predrilled holes in building/anchor points to guarantee that fasteners do not damage builkding/anchor points.
D. Fasteners shall be spaced not more than 2-feet o.c., typical.
E. Upon installation, nets are to be clean and free of any substance that might discolor or damage surfaces. Written cleaning instructions are to be made available from the fabric manufacturer. Damaged fabric panels should be replaceable individually on the job-site.

END OF SECTION

SECTION 12 21 13

HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Horizontal slat louver blinds.
B. Operating hardware.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. WCMA A100.1 - Safety of Window Covering Products 2018.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the placement of concealed blocking to support blinds. See Section 06 10 00.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data indicating physical and dimensional characteristics.
C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
D. Samples: Submit two samples, 8 inch (200 mm) long illustrating slat materials and finish, cord type and color.

E. Manufacturer's Installation Instructions: Indicate special procedures.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Slats: 20 of each type and size.
   3. Extra Lift Cords, Control Cords, and Wands: One of each type.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Horizontal Louver Blinds:
   1. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com/#sle.
   2. SWFcontract, a division of Spring Window Fashions, LLC: www.swfcontract.com/#sle.
   3. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

2.2 BLINDS

A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.
B. Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.
C. Metal Slats: Spring tempered pre-finished aluminum; square slat corners, with manufacturing burrs removed.
   1. Width: 1 inch (25 mm).
   2. Thickness: 0.008 inch (0.20 mm).
   3. Color: As selected by Architect.
D. Slat Support: Woven polypropylene cord, ladder configuration.

E. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
F. Bottom Rail: Pre-finished, formed steel; with end caps.
   1. Color: Same as headrail.
G. Lift Cord: Braided nylon; continuous loop; complying with WCMA A100.1.
   1. Free end weighted.
   2. Color: As selected by Architect.
H. Control Wand: Extruded hollow plastic; hexagonal shape.
   1. Non-removable type.
   2. Length of window opening height less 3 inch (76 mm).
I. Headrail Attachment: Wall brackets.
J. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION

A. Determine sizes by field measurement.
B. Fabricate blinds to fit within openings with uniform edge clearance of 1/4 inch (6 mm).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings are ready to receive the work.
B. Ensure structural blocking and supports are correctly placed. See Section 06 10 00.

3.2 INSTALLATION

A. Install blinds in accordance with manufacturer's instructions.
B. Secure in place with flush countersunk fasteners.

3.3 TOLERANCES

A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch (6 mm).
B. Maximum Offset From Level: 1/8 inch (3 mm).

3.4 ADJUSTING

A. Adjust blinds for smooth operation.

3.5 CLEANING

A. Clean blind surfaces just prior to occupancy.

END OF SECTION

SECTION 13 34 19

METAL BUILDING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufacturer-engineered, shop-fabricated structural steel building frame.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 05 50 00 - Metal Fabrications.
C. Section 07 21 16 - Pre-Engineered Building Blanket Insulation .
D. Section 07 41 13 - Metal Roof Panels .
E. Section 07 42 13 - Metal Wall Panels .
F. Section 07 92 00 - Joint Sealants: Sealing joints between accessory components and wall system.
G. Section 08 11 13 - Hollow Metal Doors and Frames.
H. Section 08 33 23 - Overhead Coiling Doors .
I. Section 08 80 00 - Glazing.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. 23 CFR 635.410 - Buy America requirements 2011.
B. AISC 360 - Specification for Structural Steel Buildings 2016 (Revised 2021).
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021.
H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2014.
I. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality 2014.
J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
K. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
L. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2017.
M. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2019, with Editorial Revision (2020).
N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.
O. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
P. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems 2018.
Q. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).
R. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on profiles, component dimensions, fasteners.
C. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and installation; framing anchor bolt settings, sizes, locations from datum, and foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
D. Manufacturer's Instructions: Indicate preparation requirements, anchor bolt placement, and special conditions.
E. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.
F. Designer's Qualification Statement.
G. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under IAS AC472.

H. Erector's Qualification Statement.
I. Buy American Certification: Upon delivery of product, provide notarized original of TxDOT Form 1818 (aka Form D-9-USA-1) with the proper attachments for verification of compliance.
J. Project Record Documents: Record actual locations of concealed components and utilities.

1.7 QUALITY ASSURANCE

A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
   1. Design Engineer Qualifications: Licensed in TEXAS.
   2. Comply with applicable code for submission of design calculations as required for acquiring permits.
   3. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.
B. Perform work in accordance with AISC 360 and MBMA (MBSM).
   1. Maintain one copy on site.
C. Buy America: Manufacturer shall provide products complying with the latest provisions of Buy America as listed at 23 CFR 635.410. For steel and iron materials, all manufacturing processes, including application of a coating, must occur in the United States.
D. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
   1. Not less than five years of documented experience.
E. Erector Qualifications: Company specializing in performing the work of this section with minimum five years experience.

1.8 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.

1.9 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
   1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Buildings Systems:
   1. Butler Manufacturing Company: www.butlermfg.com/#sle.
   2. Ceco Building Systems: www.cecobuildings.com/#sle.
   3. Metallic Building Company: www.metallic.com/#sle.
   4. Nucor Building Systems: www.nucorbuildingsystems.com/#sle.
   5. VP Buildings: www.vp.com/#sle.
   6. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
      a. See article in PART 1 above entitled "Available Manufacturers".

2.2 ASSEMBLIES

A. Single span rigid frame.
B. Bay Spacing: 28 ft (8.53 m), maximum. Refer to the drawings.
C. Primary Framing: Rigid frame of rafter beams and columns, canopy beams, braced end frames, and end wall columns, and wind bracing.
D. Secondary Framing: Purlins, and other items detailed.
E. Wall System: Preformed metal panels of horizontal and vertical profile, with sub-girt framing/anchorage assembly, and accessory components.
F. Roof System: Preformed metal panels oriented parallel to slope, with sub-girt framing/anchorage assembly and roof insulation system, and accessory components.
G. Roof Slope: 1 inches in 12 inches (1/12).

2.3 PERFORMANCE REQUIREMENTS

A. Design structural members to withstand dead load, applicable snow load, and design loads due to pressure and suction of wind calculated in accordance with applicable code.
B. Design structural members to withstand Class 30 wind uplift in accordance with UL 580.
C. Exterior wall and roof system shall withstand imposed loads with maximum allowable deflection of 1/90 of span.
D. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.

2.4 MATERIALS - FRAMING

A. Structural Steel Members: ASTM A36/A36M.
B. Structural Tubing: ASTM A500/A500M Grade B cold-formed.
C. Plate or Bar Stock: ASTM A529/A529M, Grade 50.
D. Anchor Bolts: ASTM A307, Grade A, with no preference for protective coatings.
E. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1; galvanized to ASTM A153/A153M.
F. Welding Materials: Perform in accordance with AWS D1.1/D1.1M.
G. Primar: SSPC - Paint ~~20 zinc rich~~. **15**
H. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch (13.7 MPa).
2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).

2.5 ACCESSORIES

A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Designation SS (structural steel), Grade 33 (230), with G90/Z275 coating.
B. Joint Seal Gaskets: Manufacturer's standard type.
C. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A153/A153M, finish to match adjacent surfaces when exterior exposed.
D. Sealant: ASTM C920, elastomeric sealant with movement capability of at least plus/minus 50 percent; 100 percent silicone; for exposed applications, match adjacent colors as closely as possible.
E. Roof Curbs: Insulated metal same as roofing, 2 inch (50 mm) thick, designed for imposed equipment loads, anchor fasteners to equipment, counterflashed to metal roof system.
F. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Rain Water Diverter, Fascias, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.6 COMPONENTS

A. Doors and Frames: Specified in Section 08 11 13.
B. Overhead Doors: Specified in Section 08 33 23 .

2.7 FABRICATION - FRAMING

A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.
B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.
C. Provide wall opening framing for doors, windows, and other accessory components.

2.8 FABRICATION - WALL AND ROOF PANELS

A. Siding and Liner Panels: Refer to Section 07 42 13 .
B. Roofing: Refer to Section 07 41 13 .
C. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.

2.9 FABRICATION - GUTTERS AND DOWNSPOUTS

A. Fabricate of same material and finish as metal wall panel.
B. Form gutters and downspouts of square profile and size indicated to collect and remove water. Fabricate with connection pieces.
C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FINISHES

A. Framing Members: Clean, prepare, and shop prime. Do not prime surfaces to be field welded. ~~Framing Members at Maintenance Building: Clean, prepare, and galvanize to ASTM A123/A123M.~~
B. **Primary Framing Members and PEMB structure exposed to view at the Maintenance Building: Clean, prepare, and galvanize to ASTM A123/A123M.**

C. **All PEMB Framing Members at the Covered Storage Structure and the Bay Canopy Structure: Clean, prepare, and galvanize to ASTM A123/A123M.**

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.2 ERECTION - FRAMING

A. Erect framing in accordance with AISC 360.
B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
C. Set column base plates with non-shrink grout to achieve full plate bearing.
D. Do not field cut or alter structural members without approval.
E. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 ERECTION - WALL AND ROOF PANELS

A. Install in accordance with manufacturer's instructions.
B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
C. Fasten cladding system to structural supports, aligned level and plumb.
D. Locate end laps over supports. End laps minimum 2 inches (50 mm). Place side laps over bearing.
E. Provide expansion joints where indicated.
F. Use concealed and exposed fasteners as required for wall and roof panel type.
G. Install insulation and vapor retarder . See Section 07 21 16 - Pre-Engineered Building Blanket Insulation.
H. Install sealant and gaskets, providing weather tight installation.

3.4 ERECTION - GUTTERS AND DOWNSPOUTS

A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
B. Slope gutters minimum 1/8 inch/ft (10.4 mm/m).
C. Install splash blocks under each downspout.

3.5 INSTALLATION - ACCESSORY COMPONENTS IN WALL SYSTEM

A. Install door frames, doors, overhead doors, and windows and glass in accordance with manufacturer's instructions.

3.6 TOLERANCES

A. Framing Members: 1/4 inch (6 mm) from level; 1/8 inch (3 mm) from plumb.
B. Siding and Roofing: 1/8 inch (3 mm) from true position.

END OF SECTION

SECTION 14 45 00

VEHICLE LIFTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Four Post runway/platform vehicle lifts.

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 11 13 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Section 03 30 00 - Cast-in-Place Concrete .
C. Divsion 26 Sections: Wiring connections.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ALI: Automotive Lift Institute.
B. ANSI/ALI ALCTV: Safety Requirements for the Construction, Testing, and Validation of Automotive Lifts.
C. 29 CFR 1910 - Occupational Safety and Health Standards current edition.
D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
E. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength 2020.
F. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
G. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel 2018.
H. ITS (DIR) - Directory of Listed Products current edition.
I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
J. UL (DIR) - Online Certifications Directory Current Edition.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of vehicle parking lift system with adjacent construction using necessary attachments; provide anchoring devices in accordance with manufacturers installation instructions; coordinate installation of cast-in-place components.
   1. Electrical System: Coordinate utility and electrical system connections to ensure they are made in an orderly and expeditious manner.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on material descriptions, construction details, component dimensions and profiles, and finishes; including data on rated capacities, electrical and operating characteristics, and necessary accessories.
C. Shop Drawings: Provide plans, elevations, sections, and attachment details; include equipment assembly details with dimensions, weights, loads, required clearances, components, size and location of anchors and required field connections, and methods for field assembly; provide diagrams indicating signal, power, and control wiring.
D. Manufacturer's qualification statement.
E. Installer's qualification statement.
F. Warranty Documentation: Manufacturer's warranty, ensure that forms have been completed in Owner's name and registered with manufacturer.
G. Maintenance Materials: Provide the following for Owner's use in maintenance of vehicle parking lifts and equipment.
   1. See Section 01 60 00 - Product Requirements for additional provisions.
   2. Provide technical information for servicing operating equipment.
   3. Spare Parts: Provide parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
   4. Provide legible schematic wiring diagrams of installed electrical equipment, and changes made to this part of work; list symbols corresponding to identity or markings on vehicle lifts structural and electrical components.
   5. Provide lubrication chart.
   6. Tools: One of each special tool, as required for maintenance of designated equipment.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience and approved by manufacturer.

1.8 FIELD CONDITIONS

A. Existing Conditions: Verify existing dimensions of project construction adjacent to vehicle lift system location.

1.9 WARRANTY

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional warranty requirements.
B. Provide five year manufacturer warranty for structural parts, two years for hydraulic cylinders and power unit, and one year for other parts.

1.10 AVAILABLE MANUFACTURERS

A. Substitutions: The product(s) referenced by the manufacturer listed, forms the basis of design (BOD). The contractor at their option may propose an alternate manufacturer as an equal, however, if an equal is proposed, the Contractor shall provide data from the specified manufacturer & product(s) as well as equivalent data from the proposed manufacturer for a comparison, review, and determination of acceptance (approval or disapproval) by the Architect. Approval cannot be made if adequate comparison information is not provided. Absence of specified manufacturers' data is grounds for disapproval.
    1. Provide a complete, thorough, and clear identification of the proposed substitution inclusive of important product data enabling a direct comparison to the specified product(s) or item(s) including specified options and additional features.
B. Refer to Section 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements, for limitations, requirements, and procedures for proposing substitutions.

PART 2 PRODUCTS

2.1 VEHICLE LIFTS

A. Manufacturers:
    1. BendPak Inc.; HDS-27: www.bendpak.com.
    2. Substitutions: See Sections 01 25 00 - Substitution Procedures and 01 60 00 - Product Requirements.
        a. See article in PART 1 above entitled "Available Manufacturers".

2.2 FOUR-POST LIFTS:

A. Lifting Capacity: 27,000 lb (12,247 kg), maximum.
B. Runway Height: 8.5 inches (216 mm), minimum.
C. Approach Ramp Length: 48 inches (1219 mm).
D. Rise: 60 inches (1524 mm).
E. Lifting Height: 68.5 inches (1740 mm).
F. Overall Dimensions:
    1. Length: 309.25 inches (7856 mm).
    2. Width: 154 inches (3912 mm).
G. Drive-Thru Clearance: 109 inches (2769 mm).
H. Runway Width: 22 inches (559 mm).
I. Length of Runways: 309 inches (7845 mm).
J. Locking Positions: 9.
K. Lock Spacing: Every 6 inches (152 mm).
L. Lifting Time: 75 seconds.

2.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide factory fabricated structures capable of withstanding the lifting loads and stresses without damage or failure.
   1. Fabricate frame and platform using structural or formed-steel shapes, welded to supports; assembly to withstand deformation during operating and stored periods.

B. Provide vehicle lift system as indicated with necessary capacity, size, operation, function, and construction; with safety devices, controls, and accessories complying with applicable standards of 29 CFR 1910.

C. Provide concrete fasteners meeting the criteria as prescribed by ANSI/ALI ALCTV.

2.4 OPERATING SYSTEM

A. Hydraulic: Electric controlled lift system from remote-control station using electric-powered hydraulic units for raising and lowering lift platform; unitized assembly, totally enclosed, and includes nonventilated electric motor, pump, manifold reservoir, and valves.
   1. Hydraulic system shall be designed to operate using standard 10-weight, non-foaming, non-detergent hydraulic oil or Dexron-III ATF fluid.

2.5 MATERIALS

A. Rolled Steel Sections, Shapes, and Rods: Comply with ASTM A36/A36M.

B. Anchor Bolts and Rods: Comply with ASTM F1554, Grade 55.

C. Welding: Comply with applicable requirements of AWS D1.1/D1.1M and AWS D1.3/D1.3M.

D. Lifting Cables: Stainless steel.

2.6 EQUIPMENT

A. Lubrication of Equipment: Provide grease fittings for lubricating bearings requiring periodic lubrication, automatic feed type grease cups, and visible and easily accessible lubrication points.

2.7 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics:
   1. 220 volts, single phase, 60 Hz.
   2. System wiring connections, see Division 26 Sections.
   3. System wiring devices, see Division 26 Sections.

B. Electrical Components, Boxes, Conduit, Wiring, and Devices: Comply with NFPA 70, and UL (DIR) or ITS (DIR) listed and labeled, and marked as applicable for proposed locations.

2.8 FINISHES

A. Baked-On Factory Finish for Structural Metal Surfaces: Clean surfaces of rust, oil or grease and wipe clean with solvent; apply manufacturer's standard two-coat, baked-on finish consisting of primer and thermosetting top coat.
   1. Color: Manufacturer's standard color.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that areas and conditions are in compliance with installation tolerances and other conditions affecting this work.
B. Verify that locations for electrical rough-in connections to system equipment are in acceptable locations prior to installing equipment.
C. Verify that electrical power is available and of correct characteristics.
D. Do not proceed with installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install vehicle lift system and components in accordance with manufacturer's written installation instructions.
B. Install vehicle lift system securely to supporting structure, and flush with adjacent surfaces.
C. Install structural components using methods that comply with requirements indicated relative to layout and structural position.

3.3 ADJUSTING

A. Adjust lift equipment to operate smoothly and safely.
B. Verify vertical travel of lift system, and adjust as necessary to maintain operating range indicated.
C. After installation, inspect exposed factory finished lift equipment, and repair damaged finishes.

3.4 CLEANING

A. Remove protective coverings from finished surfaces.
B. Clean surfaces and components.

3.5 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation and maintenance of system.
    1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
    2. Provide minimum of two hours of training.
    3. Instructor: Manufacturer's training personnel.
    4. Location: At project site.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase, 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.

1.2 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.

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 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: Pre-lubricated, 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 SUMMARY

A. Section Includes:
1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 ACTION 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. PVC-Pipe Sleeves: ASTM D 1785, Schedule 80.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

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. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; 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.

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.

3.2 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.

3.3 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.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves.
   2. Exterior Concrete Walls below Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall 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: Cast-iron wall 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.
   3. Concrete Slabs-on-Grade:
      a. Piping Smaller Than NPS 6: Galvanized-steel wall 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: Cast-iron wall 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.
   4. Concrete Slabs above Grade:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves, PVC-pipe sleeves, or stack-sleeve fittings.
      b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or stack-sleeve fittings.
   5. 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 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated, and rough-brass finish and setscrew fastener.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

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 type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
      h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.

j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

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: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. 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 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. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Bimetallic-Actuated Thermometers:
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. Ashcroft Inc.
b. Tel-Tru Manufacturing Company.
c. Trerice, H. O. Co.
d. Watts; a Watts Water Technologies company.
e. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: sealed type; stainless steel with 3-inch nominal diameter.

4. Dial: Non-reflective aluminum with permanently etched scale markings and scales in deg F.
5. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
6. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
7. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
8. Window: Plain glass.
9. Ring: Stainless steel.
10. Element: Bimetal coil.
11. Pointer: Dark-colored metal.
12. Accuracy: Plus or minus 1.5 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
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. Tel-Tru Manufacturing Company.
   b. Trerice, H. O. Co.
   c. Weiss Instruments, Inc.
   d. Watts; a Watts Water Technologies company.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
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. Tel-Tru Manufacturing Company.
   b. Trerice, H. O. Co.
   c. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.

8. Stem: Aluminum and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:
   1. Standard: ASME B40.200.
   2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   3. Material for Use with Copper Tubing: CNR or CUNI.
   4. Material for Use with Steel Piping: CRES.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Length required to match thermometer bulb or stem.
   10. Lagging Extension: Include on thermowells for insulated piping and tubing.
   11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   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. Ashcroft Inc.
      b. Tel-Tru Manufacturing Company.
      c. Trerice, H. O. Co.
      d. Watts; a Watts Water Technologies company.
      e. Weiss Instruments, Inc.
   2. Standard: ASME B40.100.
   3. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
   4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   6. Movement: Mechanical, with link to pressure element and connection to pointer.
   7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
   8. Pointer: Dark-colored metal.
   9. Window: Glass.
   10. Ring: Metal.
   11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

K. Install pressure gages in the following locations:

1. Building water service entrance into building.

2. Inlet and outlet of each pressure-reducing valve.

L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

M. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
   1. Sealed, bimetallic-actuated type.
   2. Metal case, compact or industrial-style, liquid-in-glass type.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F.

3.4 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:
   1. Sealed, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
   1. Sealed, direct-mounted, metal case.
   2. Test plug with EPDM self-sealing rubber inserts.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi.

B. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION

SECTION 22 05 23.12

BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Brass ball valves.
2. Bronze ball valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.
1. Certification that products comply with NSF 61 Annex G.

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 B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G 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 non-thermal-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, Two-Piece with Full Port and Brass Trim:
   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. Apollo Valves; Conbraco Industries, Inc.
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Watts; a Watts Water Technologies company.
   2. Description:
      a. Standard: MSS SP-110.
      b. CWP Rating: 600 psig.
      c. Body Design: Two 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, Two-Piece with Full Port and Bronze or Brass Trim:
   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. Apollo Valves; Conbraco Industries, Inc.
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Watts; a Watts Water Technologies company.
   2. Description:
      a. Standard: MSS SP-110.
      b. CWP Rating: 600 psig.
      c. Body Design: Two piece.
      d. Body Material: Bronze.
      e. Ends: Threaded.
      f. Seats: PTFE.
      g. Stem: Bronze or brass.
      h. Ball: Chrome-plated brass.
      i. Port: Full.

PART 3 - EXECUTION

3.1 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.

3.2 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 is indicated in valve schedules below.
   2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.3 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Brass ball valve, one piece.
   3. Bronze ball valve, one piece with bronze trim.
   4. Brass ball valves, two-piece with full port and brass trim.
   5. Bronze ball valves, two-piece with full port and bronze or brass trim.

END OF SECTION

SECTION 22 05 23.13

BUTTERFLY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Iron, single-flange butterfly valves.
2. Chainwheels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.
1. Certification that products comply with NSF 61 Annex G.

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 B16.1 for flanges on iron valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B31.9 for building service piping valves.

C. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Types:
1. Gear Actuator: For valves NPS 8 and larger.
2. Handlever: For valves NPS 6 and smaller.
3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Valve Installation" Article.

G. Valves in Insulated Piping: With 2-inch stem extensions.

2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with Ductile-Iron Disc:

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. Apollo Valves; Conbraco Industries, Inc.
   b. Hammond Valve.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. Watts; a Watts Water Technologies company.
2. Description:
   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Nickel-plated ductile iron.

2.3 CHAINWHEELS

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. Babbitt Steam Specialty Co.
   2. Roto Hammer Industries.
   3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, chain guides, chain.
   1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
   2. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 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 butterfly valves NPS 4 and larger and more than 96 inches Insert dimension above floor. Extend chains to 60 inches above finished floor.

3.2 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.

3.3 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, ductile-iron disc.

END OF SECTION

SECTION 22 05 23.14

CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bronze swing check valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61 Annex G.

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 B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   3. ASME B16.18 for solder joint.
   4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G 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 Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:
   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. Apollo Valves; Conbraco Industries, Inc.

b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts; a Watts Water Technologies company.

2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

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. Apollo Valves; Conbraco Industries, Inc.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts; a Watts Water Technologies company.

2. Description:
a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: PTFE.

PART 3 - EXECUTION

3.1 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 swing check valves for proper direction of flow in horizontal position with hinge pin level.

3.2 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.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze or non-metallic disc.

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.
   2. For Steel Piping, NPS 2 and Smaller: Threaded.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze swing check valves bronze disc, Class 125, with soldered or threaded end connections.

END OF SECTION

SECTION 22 05 23.15

GATE VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Bronze gate valves.
2. Iron gate valves.
3. Chainwheels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.
1. Certification that products comply with NSF 61 Annex G.

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. NSF Compliance: NSF 61 Annex G 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, NRS, Class 125:
   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. Apollo Valves; Conbraco Industries, Inc.
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Watts; a Watts Water Technologies company.
   2. Description:
      a. Standard: MSS SP-80, Type 1.
      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 125:
   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. Apollo Valves; Conbraco Industries, Inc.
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Watts; a Watts Water Technologies company.
   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.

2.3 IRON GATE VALVES

A. Iron Gate Valves, NRS, Class 125:
   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. Apollo Valves; Conbraco Industries, Inc.
      b. Hammond Valve.

c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts; a Watts Water Technologies company.

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.

B. Iron Gate Valves, OS&Y, Class 125:

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. Apollo Valves; Conbraco Industries, Inc.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts; a Watts Water Technologies company.

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 CHAINWHEELS

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. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, chain guides, chain.
1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
2. Chain: Hot-dip galvanized steel of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze gate valves, NRS or RS, Class 125.

B. Pipe NPS 2-1/2 and Larger: Iron gate valves, OS&Y, Class 125 with flanged ends.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. 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 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include Product Data for components:
1. Trapeze pipe hangers.
2. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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.

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: Pre-galvanized 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 or stainless 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 or stainless- 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 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.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 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, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Non-staining, 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. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. 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.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal 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.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. 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.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. 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.

M. 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.

3.2 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. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 specifications.

C. 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 and metal trapeze pipe hangers 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 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 non-insulated 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. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
6. 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.
7. 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.
8. 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.
9. 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.

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.

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. 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.

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

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.
   3. 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.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. 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 33

HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plumbing piping heat tracing for freeze prevention with the following electric heating cables:
   1. Self-regulating, parallel resistance.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electric heating cable.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

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. Chromalox, Inc.
   2. Delta-Therm Corporation.
   3. Nelson Heat Trace.
   4. Raychem; Pentair Thermal Management.
   5. Thermon Americas Inc.

B. Comply with IEEE 515.1.

C. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to

temperature along its length. Terminate with waterproof, factory-assembled, non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Cable Cover: Tinned copper braid and polyolefin outer jacket with ultraviolet inhibitor.

F. Maximum Operating Temperature (Power On): 150 deg F.

G. Maximum Exposure Temperature (Power Off): 185 deg F.

H. 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.

I. Capacities and Characteristics:
   1. Maximum Heat Output: 5 W/ft.
   2. Electrical Characteristics for Single-Circuit Connection:
      a. Volts: 120.

2.2 CONTROLS

A. Pipe-Mounted Thermostats for Freeze Protection:
   1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
   2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
   3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
   4. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Section 22 05 53 "Identification for Plumbing Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
   1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
   2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Freeze Protection for Piping:
   1. Install electric heating cables after piping has been tested and before insulation is installed.
   2. Install electric heating cables according to IEEE 515.1.
   3. Install insulation over piping with electric cables according to Section 22 07 19 "Plumbing Piping Insulation."
   4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

C. Set field-adjustable switches and circuit-breaker trip ranges.

D. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to 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. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
   2. Test cables for electrical continuity and insulation integrity before energizing.
   3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. Remove and replace damaged heat-tracing cables.

END OF SECTION

SECTION 22 05 48

VIBRATION CONTROL FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Mechanical anchor bolts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each vibration isolation and restraint device.
1. Include design calculations and details for selecting vibration isolators and restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Welding certificates.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Comply with requirements in the IBC unless requirements in this Section are more stringent.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Smooth pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:
1. Mounting Plates:
a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:
1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
   1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
      a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
      b. Top housing with attachment and leveling bolt.

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
   1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
      a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
      b. Top plate with threaded mounting holes.
      c. Internal leveling bolt that acts as blocking during installation.
   2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
   3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
   1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
      a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
      b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
   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.

2.8 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
   1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
   2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.9 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
   1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.10 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
   1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.11 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-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. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.12 SNUBBERS

A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be drill-in, and stud-wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.13 RESTRAINT CHANNEL BRACINGS

A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.14 RESTRAINT CABLES

A. Restraint Cables: ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to forces.

C. Strength of Support and Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static within specified loading limits.

3.2 VIBRATION CONTROL AND RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Equipment Restraints:
   1. Install snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

D. Piping Restraints:
1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: 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. Letter Color: White.
   3. Background Color: Black.
   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 up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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.

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) and 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, 1/16 inch for units up to 20 square inches, 1/8-inch-thick for larger units, and having predrilled holes for attachment hardware.

B. Letter Color: White.

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-quarters 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. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include 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: Size letters according to ASME A13.1 for piping.

PART 3 - EXECUTION

3.1 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.2 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 09 specifications.

B. 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. 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 and on both sides of 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:
   1. Domestic Water Piping
      a. Background: Comply with ASME A13.1.
      b. Letter Colors: Comply with ASME A13.1.
   2. Sanitary Waste and Storm Drainage Piping:
      a. Background: Comply with ASME A13.1.
      b. Letter Colors: Comply with ASME A13.1.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.
   3. Domestic recirculating hot water piping.
   4. Sanitary waste piping exposed to freezing conditions.
   5. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

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, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 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.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Supply and Drain Protective Shielding Guards: ICC A117.1.

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 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. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Special-Shaped Insulation: ASTM C 552, Type III.
   2. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
   3. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
   4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

H. Mineral-Fiber, Preformed Pipe Insulation:
   1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

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. Materials shall meet emissions requirement and have no added formaldehyde binders.

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.
   1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive 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."

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, 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, 58 percent by volume and 70 percent by weight.
   4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Solids Content: 60 percent by volume and 66 percent by weight.
   4. Color: White.

2.5 SEALANTS

A. Joint Sealants for Cellular-Glass Products:
   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. FSK and 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 Vinyl, PVDC, 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.

2.6 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 C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.
   2. Color: White.
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   1. Finish and thickness are indicated in field-applied jacket schedules.
   2. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.
   3. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.

4. Factory-Fabricated Fitting Covers:
    a. Same material, finish, and thickness as jacket.
    b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    c. Tee covers.
    d. Flange and union covers.
    e. End caps.
    f. Beveled collars.
    g. Valve covers.
    h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.9 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.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. 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.

2.10 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, galvanized steel.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. 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. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 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.

3.2 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 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 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 2 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, 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 pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 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. Cleanouts.

3.3 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 for 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.

3.4 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. Insulation shall be continuous. This includes piping at piping hangars and supports.

D. 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.

E. 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.

3.5 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 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 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.

3.6 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 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 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE 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 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 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Seal split-tube 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 polyolefin 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 polyolefin 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 cut sections of polyolefin pipe and sheet 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.
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.

3.9 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.

B. 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.

C. 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 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. Perform tests and inspections.

B. Tests and Inspections:
   1. 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 three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 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.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Water Piping: Insulation shall be one of the following:
   1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be one of the following:
   1. Flexible Elastomeric: 1 inch thick.
   2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   3. Polyolefin: 1 inch thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed: Mineral-fiber, preformed pipe insulation, Type I, 1-1/2 inches thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping: Insulation shall be one of the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Sanitary Waste Piping Where Heat Tracing Is Installed: Insulation shall be one of the following:
1. Cellular Glass: 2 inches thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.15 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

3.16 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. None.
2. PVC: 30 mils thick.

D. Piping, Exposed:
1. PVC, Color-Coded by System: 30 mils thick.

3.17 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. Piping, Concealed:
1. PVC, Color-Coded by System: 30 mils thick.

C. Piping, Exposed:
1. PVC: 30 mils thick.

3.18 UNDERGROUND, FIELD-INSTALLED 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. Copper tube and fittings.
2. Piping joining materials.
3. Transition fittings.
4. Dielectric fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

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.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

C. Comply with NSF Standard 372 for low lead.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type K water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
1. AWWA C110/A21.10, rubber, flat face, 1/8-inch-thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 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. Plastic-to-Metal Transition Fittings:
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. Charlotte Pipe and Foundry Company.
   b. Spears Manufacturing Company.
   c. Uponor.
2. Description:
   a. One end with threaded brass insert and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:
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. NIBCO INC.
   b. Spears Manufacturing Company.
2. Description:

a. Brass or stainless-steel threaded end.
b. Solvent-cement-joint or threaded plastic end.
c. Rubber O-ring.
d. Union nut.

2.5 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. Standard: ASSE 1079.
2. Pressure Rating: 150 psig.
3. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 150 psig.
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Non-conducting materials for field assembly of companion flanges.
2. Pressure Rating: 150 psig.
3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:
1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F 1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements for excavating, trenching, and backfilling.

3.2 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. All buried water piping, including under slab, shall be bedded in sand, a minimum of 4 inches on all sides, and shall be a minimum of 24 inches below finished grade or floor.

D. All water piping shall be sloped to a drainable location. All piping shall be drainable.

E. 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 for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."

H. Install domestic water piping level and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. 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.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."

S. Install thermostats in hot-water circulation piping.

T. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, 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.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: 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."

F. 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.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for 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 unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
   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. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for 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. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   4. 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.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. 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:
         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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Re-inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections, and arrange for re-inspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   2. Piping Tests:
      a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
      b. 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.

c. 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.
d. 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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 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 hot-water flow 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.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. 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:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:
1) 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.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

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. Under-building-slab, domestic water, building-service piping, (to a point 12" above finished floor) shall be the following:
1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
a. No joint in inaccessible areas under slabs unless silver soldered.

C. Aboveground domestic water piping, shall be the following:
1. Hard copper tube, ASTM B 88, Type K cast- or wrought-copper, solder-joint fittings, and soldered joints.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 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.

B. Hose-Connection Vacuum Breakers:
1. Standard: ASSE 1011.
2. Body: Bronze, non-removable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/2.
4. Body: Bronze.
5. End Connections: Union, solder joint.
6. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:
1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies 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. Configuration: Refer to drawings.
7. Accessories:
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
   c. 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 third of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies 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. Configuration: Refer to drawings.
7. Accessories:
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies 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.

2.6 BALANCING VALVES

A. 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.

2.7 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 union inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

B. Primary, Thermostatic, Water Mixing Valves:
1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Type: Exposed-mounted, 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.

2.8 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 that complies with AWWA C550 or that is FDA approved, epoxy coated 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: 0.033 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
   c. Strainers NPS 5 and Larger: 0.125 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.9 HOSE BIBBS

A. Hose Bibbs:
1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Non-freeze Wall Hydrants:
1. Standard: ASME A112.21.3M for 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 mounted with cover.
8. Box and Cover Finish: Polished nickel bronze.
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
11. Operating Keys(s): Two with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:
   1. Standard: ASSE 1019, Type A or Type B.
   2. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
   3. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
   4. Pressure Rating: 125 psig.
   5. Operation: Loose key or wheel handle.
   6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
   7. Inlet: NPS 1/2 or NPS 3/4.
   8. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.11 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.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
   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. Jay R. Smith Mfg. Co.
      b. Watts; a Watts Water Technologies company.
      c. Zurn Industries, LLC.
   2. Standard: ASSE 1010 or PDI-WH 201.
   3. Type: Stainless Steel welded nested bellows.
   4. Size: ASSE 1010, Sizes AA and A through F, or PDI, Sizes A through F.

2.13 TRAP-SEAL PRIMER DEVICE

A. Drainage-Type, Trap-Seal Primer Device:
   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. Jay R. Smith Mfg. Co.
   2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
   3. Size: NPS 1-1/4 minimum.

4. 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 airgap 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 unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve and pump.

F. Set non-freeze, non-draining-type post hydrants in concrete or pavement.

G. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

H. Install water-hammer arresters in water piping according to PDI-WH 201.

I. 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.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

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. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 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 11 23

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig and is reduced to secondary pressure of 0.5 psig or less.

D. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

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.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Galvanized steel and copper piping and fittings are specifically prohibited for use as fuel gas piping.

B. Piping size changes shall be made by using bell reducers or reducing fittings. The use of bushings is prohibited.

C. Steel Pipe: ASTM A 53/A 53M, 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 A 234/A 234M for butt welding.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. 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.

D. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
   1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
   2. Coating: PE with flame retardant.
      a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 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: 50 or less.
   3. Fittings: Mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include threaded ends complying with ASME B1.20.1.
   4. Striker Plates: Steel, designed to protect tubing from penetrations.

5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
6. Operating-Pressure Rating: 5 psig.

E. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anode-less Service-Line Risers: Factory fabricated and leak tested.
   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
   b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
   c. Aboveground Portion: PE transition fitting.
   d. Outlet shall be threaded 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 D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
   b. Outlet shall be threaded 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.

2.2 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. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.

5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller.
3. Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. 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.

2.3 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.

2.4 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. Dry seal 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. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
2. Ball: Chrome-plated bronze.
3. Stem: Bronze; blowout proof.
4. Seats: Reinforced TFE; blowout proof.
5. Packing: Threaded-body pack nut design with adjustable-stem packing.

6. Ends: Threaded or 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.

D. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
2. Ball: Chrome-plated bronze.
3. Stem: Bronze; blowout proof.
4. Seats: Reinforced TFE.
5. Packing: Threaded-body pack nut design with adjustable-stem packing.
6. Ends: Threaded or 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 B 584.
2. Plug: Bronze.
3. Ends: Threaded, or 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.

F. PE Ball Valves: Comply with ASME B16.40.
1. Body: PE.
2. Ball: PE.
3. Stem: Acetal.
4. Seats and Seals: Nitrile.
5. Ends: Plain or fusible to match piping.
6. CWP Rating: 80 psig.
7. Operating Temperature: Minus 20 to plus 140 deg F.
8. Operator: Nut or flat head for key operation.
9. Include plastic valve extension.
10. Include tamperproof locking feature for valves where indicated on Drawings.

G. Valve Boxes:
1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.

4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 MOTORIZED GAS VALVES

A. Electrically Operated Valves: Comply with UL 429.
1. Pilot operated.
2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
6. NEMA ICS 6, Type 4, coil enclosure.
7. Normally closed.
8. Visual position indicator.

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.

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. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. 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: 2 psig.

2.7 DIELECTRIC UNIONS

A. Dielectric Unions:
   1. Description:
      a. Standard: ASSE 1079.
      b. Pressure Rating: 150 psig.
      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 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping. Where codes conflict, comply with the more stringent of the two.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in for excavating, trenching, and backfilling.
   1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. 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.
   3. 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 22 05 19 "Meters and Gages for Plumb Piping."

3.2 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping. Where codes conflict, comply with the more stringent of the two.

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. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Q. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.

S. Do not use natural-gas piping as grounding electrode.

T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Piping size changes shall be made by using bell reducers or reducing fittings. The use of bushings is prohibited.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. 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 dry seal 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.

E. 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.

F. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
   2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
   3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.6 CONNECTIONS

A. Connection to utility's gas main shall be by the utility. Coordinate as required.

B. Dirt legs and flexible gas hose shall be required at all connections to appliances and points of use.

C. Install natural-gas piping electrically continuous and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

D. Install piping adjacent to appliances to allow service and maintenance of appliances.

E. 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.

F. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

A. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

A. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction. Where there is a conflict between the two codes, comply with the more stringent of the two.

B. Natural-gas piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Galvanized steel and copper piping and fittings are specifically prohibited for use as fuel gas piping.

3.9 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:
   1. Safety yellow PE pipe and fittings joined by butt 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 piping 2 inch and smaller shall be the following:
   1. Schedule 40 black steel pipe with malleable-iron fittings and threaded joints.

C. Aboveground piping 2-1/2 inch and larger shall be the following:
   1. Schedule 40 black steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping. Containment conduit should not be required (see drawings). If required due to unforeseen conditions comply with this specification.

3.10 INDOOR PIPING SCHEDULE

A. Aboveground piping 2 inch and smaller shall be the following:
   1. Schedule 40 black steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground piping 2-1/2 inch and larger shall be the following:
   1. Schedule 40 black steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be one of the following:
   1. Safety yellow PE pipe and fittings joined by butt 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.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

B. Underground: Bronze plug valves.

3.12 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 regular-port, bronze ball valves with bronze trim.

B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
   1. Two-piece, regular-port, bronze ball valves with bronze trim.

C. Valves in branch piping for single appliance shall be one of the following:
   1. Two-piece, regular-port, bronze ball valves with bronze trim.

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.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 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.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. 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.

C. All cast iron soil pipe and fittings shall be marked with the Collective Trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International®.

D. All Standard Duty Couplings shall be certified by NSF International®

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

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. ANACO-Husky.
   b. Charlotte Pipe and Foundry Company.
   c. Tyler Pipe; a subsidiary of McWane Inc.
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop. Minimum 4 band clamps.

C. Heavy-Duty, Hubless-Piping Couplings:
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. ANACO-Husky.
   b. Charlotte Pipe and Foundry Company.
   c. Tyler Pipe; a subsidiary of McWane Inc.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop. Minimum 4 band clamps.

2.4 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Copper Pressure Fittings:
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

D. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665 and ASTM D1785, drain, waste, and vent.

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.

E. Solvent Cement: ASTM D 2564.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Non-pressure Transition Couplings:
a. Standard: ASTM C 1173.
b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.
d. Sleeve Materials:
1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
3. Shielded, Non-pressure Transition Couplings:
a. Standard: ASTM C 1460.
b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. 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.
   1. 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.
   2. 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 drainpipe.
      a. Straight tees, elbows, and crosses may be used on vent lines.
   3. Do not change direction of flow more than 90 degrees.
   4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
   1. Horizontal Sanitary: 1 percent downward in direction of flow for piping 3” and larger, 2 percent downward in direction of flow for piping 2-1/2” and smaller.
   2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground PVC piping according to ASTM D 2321.

Q. Plumbing Specialties:
   1. Install backwater valves in sanitary waster gravity-flow piping.
      a. Comply with requirements for backwater valves specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
   2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
      a. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
   3. Install drains in sanitary waste gravity-flow piping.
      a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints. Band clamps shall be stainless steel, minimum 4 band clamps.

B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

D. Plastic, Non-Pressure-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.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.
   2. In Waste Drainage Piping: Shielded, non-pressure transition couplings.

3.5 VALVE INSTALLATION

A. Comply with requirements in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.14 "Check Valves for Plumbing Piping" for general-duty valve installation requirements.

B. Shutoff Valves:
   1. Install shutoff valve on each sewage pump discharge.
   2. Install full-port ball valve for piping NPS 2 and smaller.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves.
   2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
   3. Install backwater valves in accessible locations.
   4. Comply with requirements for backwater valve specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. 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.
   7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   8. 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. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. 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. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. 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.
   4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
   5. NPS 6: 10 feet with 5/8-inch rod.
   6. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

J. Install supports for vertical PVC piping every 48 inches.

K. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 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 waste and vent piping to the following:
   1. Plumbing Fixtures: Connect waste 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 waste 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. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.
    a. Provide shutoff valve if indicated and union for each connection.
    b. 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.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.9 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 waste 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.

a. 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 waste and vent piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
   a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
   b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
   c. 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.
   a. 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.
   b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
   c. Air pressure must remain constant without introducing additional air throughout period of inspection.
   d. 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.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping 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.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil, waste and vent piping to a point at least 12” Above finished floor shall be the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

C. Aboveground, soil, waste and vent piping above 12" Above finished floor shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints. Minimum 4 band clamp hubless fittings.
   2. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

D. Underground, 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: Shielded, non-pressure transition couplings.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backwater valves.
2. Cleanouts.
3. Roof flashing assemblies.
4. Miscellaneous sanitary drainage piping specialties.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene.

B. PVC: Polyvinyl chloride.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:
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. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Tyler Pipe; a subsidiary of McWane Inc.

e. Watts; a Watts Water Technologies company.
f. Zurn Industries, LLC.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hub and spigot or hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Horizontal, Plastic Backwater Valves:

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. Oatey.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Zurn Industries, LLC.
2. Size: Same as connected piping.
3. Body: PVC.
4. Cover: Same material as body with threaded access to check valve.
5. Check Valve: Removable swing check.
6. End Connections: Socket type.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

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. Jay R. Smith Mfg. Co.
   b. Watts; a Watts Water Technologies company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Cast-Iron Exposed Floor Cleanouts:

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. Jay R. Smith Mfg. Co.

b. Watts; a Watts Water Technologies company.
c. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Riser: ASTM A 74, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

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. Jay R. Smith Mfg. Co.
   b. Watts; a Watts Water Technologies company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure Plug:
   a. Brass or Cast iron.
   b. Countersunk or raised head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counter-flashing fitting.
   a. Open-Top Vent Cap: Without cap.
   b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
   c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. 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.

C. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. 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.

E. 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.

F. Stack Flashing Fittings:
1. Description: Counter-flashing-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.

G. 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.

H. Expansion Joints:
1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.
1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

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 50 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. Cleanouts shall be installed so that the maximum amount of piping can be accessed. For sanitary cleanouts in or near restrooms, place the cleanout(s) at a higher elevation than the flood rim of the surrounding water closet fixtures.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00, Sheet Metal Flashing and Trim.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00, Sheet Metal Flashing and Trim.

H. Assemble open drain fittings and install with top of hub 2 inches above floor.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. 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 Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

C. 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.

D. Set flashing on floors and roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."

G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

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.

1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 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 19.13

SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Floor drains.
2. Floor Sinks.

1.2 DEFINITIONS

A. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:
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. Jay R. Smith Mfg. Co.
b. Watts; a Watts Water Technologies company.
c. Zurn Industries, LLC.
2. Standard: ASME A112.6.3.
3. Type: Refer to plumbing fixture schedule on drawings.

2.3 FLOOR SINKS

A. Cast-Iron Floor Sinks:
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. Jay R. Smith Mfg. Co.

b. Watts; a Watts Water Technologies company.
c. Zurn Industries, LLC.
2. Standard: ASME A112.6.3.
3. Type: Refer to plumbing fixture schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains and floor sinks at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains and floor sinks for easy access and maintenance.
2. Locate floor drains under the open area of the stall partition or where patrons are not likely to walk to avoid tripping hazards.
3. Provide floor drain in Janitor's closets.
4. Set floor drains and floor sinks below elevation of surrounding finished floor to allow floor drainage.
5. 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.
6. Install floor-drain and floor-sink flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
a. Maintain integrity of waterproof membranes where penetrated.
7. Install individual traps for floor drains and floor sinks connected to sanitary building drain, unless otherwise indicated.

B. Install open drain fittings with top of hub 2 inches above floor.

3.2 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 22 13 19 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

D. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 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 Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains and floor sinks 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 SUMMARY

A. Section Includes:
   1. Sand/Oil interceptors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of interceptor.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, 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.

PART 2 - PRODUCTS

2.1 SAND/OIL INTERCEPTORS

A. Precast Concrete Sand/Oil Interceptors: Comply with ASTM C 913.
   1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain sand and oil and to permit wastewater flow.
   2. Structural Design Loads:
      a. Light-Traffic Load: Comply with ASTM C 890, A-8.
      b. Medium-Traffic Load: Comply with ASTM C 890, A-12.
      c. Heavy-Traffic Load: Comply with ASTM C 890, A-16.
      d. Walkway Load: Comply with ASTM C 890, A-03.
   3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
   4. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, 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 A 536, Grade 60-40-18, unless otherwise indicated.
    b. Gray Iron: ASTM A 48/A 48M, Class 35, unless otherwise indicated.
    c. Include indented top design with lettering cast into cover, using wording equivalent to “SAND/OIL INTERCEPTOR."

B. Capacities and Characteristics: Refer to fixture schedule on drawings.

2.2 PRECAST CONCRETE MANHOLE RISERS

A. Precast Concrete Manhole Risers: ASTM C 478, with rubber-gasket joints.
1. Structural Design Loads:
    a. Light-Traffic Load: Comply with ASTM C 890, A-8.
    b. Medium-Traffic Load: Comply with ASTM C 890, A-12.
    c. Heavy-Traffic Load: Comply with ASTM C 890, A-16.
    d. Walkway Load: Comply with ASTM C 890, A-03.
2. Length: From top of underground 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 C 443, rubber.
6. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, 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 A 536, Grade 60-40-18, unless otherwise indicated.
2. Gray Iron: ASTM A 48/A 48M, Class 35, unless otherwise indicated.
3. Include indented top design with lettering cast into cover, using wording equivalent to the following:
    a. Sand/Oil Interceptors in Sanitary Sewerage System: "SAND/OIL INTERCEPTOR".

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Civil Specifications.

3.2 INSTALLATION

A. Equipment Mounting:
   1. Install sand/oil interceptors on cast-in-place concrete equipment base(s).
   2. Comply with requirements for equipment bases and foundations specified in Section 03 specifications.

B. Set interceptors level and plumb.

C. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

D. 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.

E. Set tops of grating frames and grates flush with finished surface.

F. Install sand/oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
   1. Above-Floor Installation: Set unit with bottom resting on floor unless otherwise indicated.
   2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
   3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
   4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

3.3 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 Division 31.
   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. Sand/Oil interceptors.

END OF SECTION

SECTION 22 15 13

GENERAL SERVICE COMPRESSED AIR PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping and related specialties for general-service compressed-air systems operating at 150 psig or less.

B. See Section 22 61 19 "Compressed-Air Equipment for Facilities" for air compressors and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
1. Pressure regulators. Include rated capacities and operating characteristics.
2. Automatic drain valves.
3. Filters. Include rated capacities and operating characteristics.
4. Lubricators. Include rated capacities and operating characteristics.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Copper Tube: ASTM B 88, Type K seamless, 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.

2.2 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.

2.3 VALVES

A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

2.4 DIELECTRIC FITTINGS

A. General Requirements for Dielectric Fittings: Combination fitting of copper alloy and ferrous materials with insulating material; suitable for system fluid, pressure, and temperature. Include threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Dielectric Unions: Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

2.5 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.

C. Air-Line Pressure Regulators: Diaphragm 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.

2.6 QUICK COUPLINGS

A. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

B. 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.

C. 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.

2.7 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 double-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 one of the following piping materials for each size range:
1. NPS 2 and Smaller: Type K, copper tube; wrought-copper fittings; and brazed joints.

B. Low-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:
1. NPS 2 and Smaller: Type K, copper tube; wrought-copper fittings; and brazed joints.

C. Drain Piping: Use the following piping materials:
1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.

3.2 VALVE APPLICATIONS

A. Comply with requirements in "Valve Applications" Article in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

B. Equipment Isolation Valves: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

3.3 PIPING INSTALLATION

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 cast-copper-alloy companion flange with gasket and brazed 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. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

J. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 22 05 19 "Meters and Gages for Plumbing Piping."

K. Install piping to permit valve servicing.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 22 05 48 "Vibration Controls for Plumbing Piping and Equipment."

O. Install unions, adjacent to each valve and at final connection to each piece of equipment and machine.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Remove scale, slag, dirt, and debris from pipe and fittings before assembly.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Apply appropriate tape or thread compound to external pipe threads.

C. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "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 unions in piping at connections of dissimilar metal piping and tubing.

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 quick couplings at piping terminals for hose connections.

H. Install hose assemblies at hose connections.

3.9 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 22 05 48 "Vibration Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or 42, clamps.

D. 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.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches of each fitting and coupling.

H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1/4: 60 inches with 3/8-inch rod.
   2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
   3. NPS 3/4: 84 inches with 3/8-inch rod.
   4. NPS 1: 96 inches with 3/8-inch rod.
   5. NPS 1-1/4: 108 inches with 3/8-inch rod.
   6. NPS 1-1/2: 10 feet with 3/8-inch rod.
   7. NPS 2: 11 feet with 3/8-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

3.10 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.11 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:
   1. Piping Leak Tests: 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.

END OF SECTION

SECTION 22 34 00

FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Commercial, atmospheric, gas-fired, storage, domestic-water heaters.
   2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated and each type of product indicated.
B. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.
B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
C. Source quality-control reports.
D. Field quality-control reports.
E. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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."

1.6 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. 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: One year.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Atmospheric, Gas-Fired, Storage, Domestic-Water Heaters:
   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. American Water Heaters.
      b. Bradford White Corporation.
      c. Lochinvar, LLC.
      d. PVI Industries, LLC.
      e. Rheem Manufacturing Company.
      f. Smith, A. O. Corporation.
   2. Standard: ANSI Z21.10.3/CSA 4.3.
   3. Storage-Tank Construction: ASME-code steel with 150-psig 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.
         2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
      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. Lining: complying with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
   4. 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. Burner: For use with atmospheric, gas-fired, domestic-water heaters and natural-gas fuel.
      g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
      h. Temperature Control: Adjustable thermostat.

i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
j. 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.

5. Special Requirements: NSF 5 construction.
6. Draft Hood: Draft diverter, complying with ANSI Z21.12.
7. Automatic Damper: ANSI Z21.66/CSA 6.14-M, thermally activated, automatic-vent-damper device with size matching draft hood.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

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. AMTROL, Inc.
   b. Smith, A. O. Corporation.
   c. Taco, Inc.
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
3. 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.
4. Capacity and Characteristics: Refer to schedule on drawings.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

F. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include pressure rating as required to match gas supply.

G. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

H. 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.

I. Pressure Relief Valves: Include pressure setting less than domestic-water heater working-pressure rating.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

J. Vacuum Relief Valves: 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.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and re-inspecting requirements and Section 017000 "Execution and Closeout Requirements" for requirements for correcting the Work.

D. Prepare test and inspection reports.

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 Specifications.
1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. 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.
4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Anchor domestic-water heaters to substrate.

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 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

C. Water heaters shall be installed in locations to avoid interferences with ductwork, lighting, and provide required maintenance and location clearances. Water Heaters shall be located to provide required clearances – Coordinate with Architect and equipment layout.

D. 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.
   3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
   4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 221123 "Facility Natural-Gas Piping."

E. 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.

F. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. 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.

G. 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 221119 "Domestic Water Piping Specialties."

H. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

I. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

J. Fill domestic-water heaters with water.

K. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

B. Comply with requirements for gas piping specified in Section 221123 "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 220553 "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 014000 "Quality Requirements" for retesting and re-inspecting requirements and Section 017000 "Execution and Closeout Requirements" for requirements 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

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Lavatories.
2. Showers.
3. Drinking fountains.
4. Kitchen sinks.
5. Mop basins.
6. Sink faucets.
7. Water closets.
8. Toilet seats.
9. Urinals.
10. Supply fittings.
11. Waste fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LAVATORIES

A. Lavatory: vitreous china, counter mounted.
1. Fixture:
a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Self-rimming for above-counter mounting.
c. Faucet-Hole Punching: Refer to schedule on drawings.
d. Faucet-Hole Location: Refer to schedule on drawings.

e. Color: Refer to schedule on drawings.
f. Mounting Material: Sealant.

2. Faucet: Refer to schedule on drawings.

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted.
1. Fixture:
a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: Refer to schedule on drawings.
d. Faucet-Hole Punching: Refer to schedule on drawings.
e. Faucet-Hole Location: Top.
f. Color: Refer to schedule on drawings.
g. Mounting Material: Extended arm chair carrier.
2. Faucet: Refer to schedule on drawings.
3. Support: Type II, extended arm concealed-arm lavatory carrier with escutcheons.
4. Lavatory Mounting Height: Refer to schedule on drawings.

B. Lavatory: Wheelchair, vitreous china, wall mounted.
1. Fixture:
a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Slab or wheelchair.
c. Nominal Size: Refer to schedule on drawings.
d. Faucet-Hole Punching: Refer to schedule on drawings.
e. Faucet-Hole Location: Top.
f. Color: Refer to schedule on drawings.
g. Mounting: For extended arm concealed-arm carrier.
2. Faucet: Refer to schedule on drawings.
3. Support: Type II, extended arm concealed-arm lavatory carrier with escutcheons.
4. Lavatory Mounting Height: Refer to schedule on drawings.

2.3 WALL MOUNTED LAVATORY SUPPORTS

A. Type II Lavatory Carrier:
1. Standard: ASME A112.6.1M.
2. Type: Extended arm.

2.4 LAVATORY FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets.
1. Standard: ASME A112.18.1/CSA B125.1.
2. Manufacturer: American Standard
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
4. Type: Manual mechanical spring-loaded, metering type.

2.5 SHOWERS

A. Showers:
1. Standard: ANSI Z124.1.2.
2. Nominal Size: Refer to schedule on drawings.
3. Bathing Surface: Slip resistant according to ASTM F 462.
4. Color: Refer to schedule on drawings.
5. Drain Location: Refer to schedule on drawings.
6. Faucet: Refer to schedule on drawings.

B. Showers: Accessible with seat, grab bar, base, and faucet.
1. Standards: ANSI Z124.1.2 and ICC/ANSI A117.1 for roll-in shower compartments.
2. Nominal Size: Refer to schedule on drawings.
3. Bathing Surface: Slip resistant according to ASTM F 462.
4. Color: Refer to schedule on drawings.
5. Drain Location: Refer to schedule on drawings.
6. Accessibility Options: Include grab bar and bench.
7. Faucet: Refer to schedule on drawings.
8. Drain: Grid, NPS 2.

2.6 SHOWER FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Shower Faucets:
1. Description: Single-handle, thermostatic mixing valve with hot- and cold-water indicators; check stops; and shower head.
2. Faucet:
   a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
   b. Body Material: Solid brass.
   c. Finish: Polished chrome plate.
   d. EPA Water Sense: Required.
   e. Operation: Single-handle, push-pull or twist or rotate control.
   f. Anti-scald Device: Integral with mixing valve.
   g. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
3. Supply Connections: NPS 1/2.
4. Shower Head:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Type: Refer to schedule on drawings.
   c. Shower Head Material: Metallic with chrome-plated finish.
   d. Spray Pattern: Refer to schedule on drawings.

2.7 DRINKING FOUNTAINS

A. Drinking Fountains: wall mounted.
1. Standards:
   a. Comply with ASME A112.19.3/CSA B45.4.

b. Comply with NSF 61 Annex G.
2. Receptor Shape: Refer to schedule on drawings.
3. Back Panel: Stainless-steel wall plate behind drinking fountain.
4. Maximum water flow: 0.5 gpm.
5. Control: Refer to schedule on drawings.
6. Drain: Grid type with NPS 1-1/4 tailpiece.
7. Supply Piping: NPS 3/8 with shutoff valve.
8. Drain Piping: ASME A112.18.2/CSA B125.2, NPS 1-1/2 chrome-plated brass P-trap and waste.
9. Support: Water Cooler Carrier.
10. Drinking Fountain Mounting Height: Refer to schedule on drawings.

2.8 DRINKING FOUNTAIN SUPPORTS

A. Water Cooler Carrier:
1. Standard: ASME A112.6.1M.

2.9 KITCHEN SINKS

A. Kitchen Sinks:
1. Fixture:
a. Standard: ASME A112.19.1/CSA B45.2 for enameled kitchen sinks.
b. Standard: ANSI Z124.3 for PMMA kitchen sinks.
c. Standard: ANSI Z124.3 and ANSI/ICPA SS-1 for solid-surface kitchen sinks.
d. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel kitchen sinks.
e. Overall Dimensions: Refer to schedule on drawings.
f. Metal Thickness: [Refer to schedule on drawings.
g. Bowl: Refer to schedule on drawings.
2. Faucet: Refer to schedule on drawings.
3. Faucet Manufacturer: Sloan.
4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multi-bowl sinks.

2.10 MOP BASINS

A. Mop Basins:
1. Fixture:
a. Standard: IAPMO/ANSI Z124.6.
b. Material: Terrazzo.
c. Nominal Size: Refer to schedule on drawings.
d. Drain: Grid with NPS 3 outlet.
e. Accessories: Provide with stainless backsplash and wall-mounted mop hooks
2. Mounting: On floor and flush to wall.
3. Faucet: Refer to schedule on drawings.
a. Manufacturer: Chicago Faucets or Approved Equal.
b. Type: Wall-braced with bucket hoot.

2.11 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type.
   1. Standard: ASME A112.18.1/CSA B125.1.
   2. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
   3. Manufacturer: Sloan.
   4. Kitchen Sink Option: Separate hand spray complying with ASSE 1025.
   5. Body Type: Refer to schedule on drawings.
   6. Body Material: Refer to schedule on drawings.
   7. Finish: Refer to schedule on drawings.
   8. Maximum Flow Rate: Refer to schedule on drawings.
   9. Handle(s): Refer to schedule on drawings.
   10. Mounting Type: Refer to schedule on drawings.
   11. Spout Type: Refer to schedule on drawings.
   12. Vacuum Breaker: Required for hose outlet.

2.12 SINK SUPPORTS

A. Type II Sink Carrier:
   1. Standard: ASME A112.6.1M.

2.13 WATER CLOSETS

A. Water Closets: Wall mounted, top spud.
   1. Bowl:
      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
      b. Material: Vitreous china.
      c. Type: Siphon jet.
      d. Style: Flushometer valve.
      e. Height: Standard.
      f. Rim Contour: Elongated.
      g. Water Consumption: 1.28 gal. per flush.
      h. Spud Size and Location: NPS 1-1/2; top.
   2. Flushometer Valve: Refer to schedule on drawings.
   3. Toilet Seat: Refer to schedule on drawings.
   4. Support: Water closet carrier.
   5. Water-Closet Mounting Height: Refer to schedule on drawings.

2.14 FLUSHOMETER VALVES

A. Manual Flushometer Valves: Sloan 111, or approved equal.
   1. Standard: ASSE 1037.
   2. Minimum Pressure Rating: 125 psig.
   3. Features: Include integral check stop and backflow-prevention device.
   4. Material: Brass body with corrosion-resistant components.

5. Exposed Flushometer-Valve Finish: Chrome plated.
6. Style: Exposed.
7. Panel Finish: Chrome plated or stainless steel.
8. Actuator: Manual.
9. Consumption: 1.28 GPF.
10. Minimum Inlet: NPS 1-1/4".

2.15 TOILET SEATS

1. Standard: IAPMO/ANSI Z124.5.
2. Material: Plastic.
3. Type: Refer to schedule on drawings.
4. Shape: Elongated rim, open front.
5. Hinge: Self-sustaining, check.
6. Hinge Material: Non-corroding metal.
7. Seat Cover: Refer to schedule on drawings.
8. Color: White.

2.16 WATER CLOSET SUPPORTS

A. Water Closet Carrier:
   1. Standard: ASME A112.6.1M.
   2. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

2.17 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, siphon jet.
   1. Fixture:
      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
      b. Material: Vitreous china.
      c. Type: Siphon jet.
      d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
      e. Water Consumption: Refer to schedule on drawings.
      f. Spud Size and Location: NPS 3/4; Refer to schedule on drawings.
      g. Outlet Size and Location: NPS 2; back.
      h. Color: White.
   2. Flushometer Valve: Refer to schedule on drawings.
   3. Waste Fitting:
      a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
      b. Size: NPS 2.
   4. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
   5. Urinal Mounting Height: Refer to schedule on drawings.

B. Urinals: Wall hung, back outlet, washout.
   1. Fixture:
      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.

b. Material: Vitreous china.
c. Type: Washout with extended shields.
d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
e. Water Consumption: Refer to schedule on drawings.
f. Spud Size and Location: NPS 3/4, Refer to schedule on drawings.
g. Outlet Size and Location: NPS 2, back.
h. Color: White.

2. Flushometer Valve: Refer to schedule on drawings.
3. Waste Fitting:
   a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
   b. Size: NPS 2.
4. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
5. Urinal Mounting Height: Refer to schedule on drawings.

2.18 URINAL FLUSHOMETER VALVES

A. Manual Flushometer Valves: Sloan 186, or approved equal.
1. Standard: ASSE 1037.
2. Minimum Pressure Rating: 125 psig.
3. Features: Include integral check stop and backflow-prevention device.
4. Material: Brass body with corrosion-resistant components.
5. Exposed Flushometer-Valve Finish: Chrome plated.
6. Style: Exposed.
7. Actuator: Manual
8. Power: Refer to schedule on drawings.
9. Consumption: 0.25 GPF
10. Minimum Inlet: 3/4”.

2.19 URINAL SUPPORTS

A. Type I Urinal Carrier:
1. Standard: ASME A112.6.1M.

B. Type II Urinal Carrier:

2.20 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Lavatory and Kitchen Sink Supply Fittings:
1. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
2. Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
   a. Operation: Loose key or wheel handle.
3. Risers:

a. Size: NPS 3/8 for lavatories.
b. Size: NPS 3/8 or NPS 1/2 for kitchen sinks.
c. Material: ASME A112.18.6, braided- or corrugated-stainless-steel flexible hose riser.

2.21 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset tailpiece for accessible lavatories.

C. Drain: Pop-up type with NPS 1-1/2 straight tailpiece as part of faucet for standard lavatories.

D. Drain: Grid type with NPS 1-1/2 offset tailpiece for accessible kitchen sinks.

E. Drain: Grid type with NPS 1-1/2 straight tailpiece for standard kitchen sinks.

F. Trap:
1. Size: NPS 1-1/2 for lavatories.
2. Size: NPS 1-1/2 for kitchen sinks.
3. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; with cleanout and chrome-plated-brass or -steel wall flange.
4. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.
5. Material: ASTM F 409 PVC one-piece trap and waste to wall and wall flange.

2.22 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; 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 EXAMINATION

A. Examine roughing-in of 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 plumbing fixtures level and plumb according to roughing-in drawings.

B. Install counter-mounting fixtures in and attached to casework.

C. 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 valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."
   2. Install stops in locations where they can be easily reached for operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified.

F. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

G. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

H. Adjust fixture flow regulators for proper flow and stream height.

I. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

J. Set floor-mounted sinks in leveling bed of cement grout.

K. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified.

L. Water-Closet Installation:
   1. Install level and plumb according to roughing-in drawings.
   2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

M. Water-Closet Support Installation:
   1. Use carrier supports with waste-fitting assembly and seal.
   2. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

N. Install toilet seats on water closets.

O. Urinal Installation:
   1. Install urinals level and plumb according to roughing-in drawings.
   2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.

3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

P. Urinal Support Installation:
1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

Q. Flushometer-Valve Installation:
1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

R. 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.

S. Install traps on fixture outlets.
1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes unless otherwise indicated.

T. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

U. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

V. Joint Sealing:
1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified.

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 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.

B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and fittings.

D. 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 SUMMARY

A. Section Includes:
   1. Combination units.
   2. Water-tempering equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

A. Accessible, Plumbed Emergency Shower with Eye/Face Wash Combination Units:

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. Acorn Safety.
   b. Bradley Corporation.
   c. Guardian Equipment Co.
   d. Haws Corporation.
   e. Speakman Company.
2. Piping:
   a. Material: Refer to schedule on drawings.
   b. Unit Supply: Refer to schedule on drawings.
   c. Unit Drain: Outlet at back or side near bottom.
3. Shower:
   a. Capacity: Not less than 20 gpm for at least 15 minutes.
   b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
   c. Control-Valve Actuator: Pull rod.
   d. Shower Head: 8-inch-minimum diameter.
   e. Mounting: Pedestal.
4. Eye/Face Wash Unit:
   a. Capacity: Not less than 3 gpm for at least 15 minutes.
   b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
   c. Control-Valve Actuator: Paddle.
   d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
   e. Receptor: bowl.
   f. Mounting: Attached to shower pedestal.
   g. Drench-Hose Option: May be provided instead of eye/face wash unit.
      1) Capacity: Not less than 3 gpm for at least 15 minutes.
      2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
      3) Mounting: Bracket on shower pedestal.

2.2 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment:
   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. Acorn Safety.
      b. Armstrong International, Inc.
      c. Bradley Corporation.
      d. Guardian Equipment Co.
      e. Haws Corporation.
      f. Lawler Manufacturing Company, Inc.
      g. Leonard Valve Company.
      h. Powers.
      i. Speakman Company.
   2. Description: Factory-fabricated equipment with thermostatic mixing valve.
      a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F

throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.

b. Supply Connections: For hot and cold water.

2.3 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 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. 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 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."

F. 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."

G. 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."

H. 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."

I. 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."

3.2 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.

3.3 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."

3.4 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 and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION

SECTION 22 61 19

COMPRESSED-AIR EQUIPMENT FOR FACILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Reciprocating air compressors.
   2. Inlet-air filters.
   3. Compressed-air filter assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: For air compressors.
   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.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the compressed-air equipment testing indicated, that is an NRTL and that is acceptable to authorities having jurisdiction.
   1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

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 compressed-air equipment mounting.

2.2 MANUFACTURERS

A. 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. Ingersoll Rand.
   2. Atlas Copco.
   3. Quincy.
   4. Sullair.

2.3 GENERAL REQUIREMENTS FOR AIR COMPRESSORS

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. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

C. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
   1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
   2. Motor Controllers: Full-voltage, combination-magnetic type with under voltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
   3. Control Voltage: 120-V ac or less, using integral control power transformer.
   4. Motor Overload Protection: Overload relay in each phase.
   5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
   6. Automatic control switches to alternate lead-lag air compressors for duplex air compressors.
   7. Instrumentation: Include discharge-air and receiver pressure gages, air-filter maintenance indicator, hour meter, air-compressor discharge-air and coolant temperature gages, and control transformer.
   8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.

D. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   1. Pressure Rating: At least as high as highest discharge pressure of connected air compressors and bearing appropriate code symbols.

2. Interior Finish: Corrosion-resistant coating.
3. Accessories: Include safety valve, pressure gage, automatic drain, and pressure regulator.

E. Mounting Frame: Fabricate base and attachment to air compressor and components.

2.4 RECIPROCATING AIR COMPRESSORS

A. Reciprocating Air Compressors:
1. Description: Packaged unit.
2. Air Compressor(s): Two-stage, stationary reciprocating air compressor.
a. Mounting: Freestanding.

B. Capacities and Characteristics:
1. Compressed-Air Service: Shop air.
2. Air Compressor(s): Single, Two-Stage.
3. Air Capacity of Each Air Compressor: 24 cfm.
4. Discharge-Air Pressure: 100 psig.
5. Motor (Each Air Compressor):
a. Horsepower: 7.5.
b. Speed: 1500 rpm.
6. Electrical Characteristics:
a. Volts: 240.
b. Phase(s): Single
c. Hertz: 60.
7. Receiver: ASME construction steel tank.
a. Orientation: Vertical arrangement.
b. Capacity: 80 gallon.
c. Finish: Powder-Coated
d. Pressure Rating: 175 psig minimum.
e. Drain: Manual valve.

2.5 INLET-AIR FILTERS

A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match capacity of air compressor, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.6 COMPRESSED-AIR FILTER ASSEMBLIES

A. Compressed-Air Filter Assemblies:
1. Description: Filter assemblies suitable for compressed air, in parallel duplex arrangement. Size each assembly for maximum capacity of connected equipment and operating

pressure of compressed-air system. Include automatic ejection of condensate from airstream, inlet and outlet pressure gages, and shutoff valves.

a. Option: Factory-fabricated filter system consisting of three air filters equivalent to those specified, pipe, fittings, valves, differential pressure switch, and enclosure; and with additional automatic drain traps and gages.

2. Size filter assemblies for 5-psig maximum air-pressure drop when filters are new and clean, at system rated capacity, and at 100-psig pressure.
3. Differential Pressure Switch: Adjustable, diaphragm type, with electrical connections for alarm system, to indicate when air-pressure drop through filters rises to more than 2 psig greater than when new and clean.
4. Particulate Filters: Collection efficiency of 98 percent retention of particles 1 micrometer and larger.
5. Odor and Taste Filters: Vapor-absorbing, activated charcoal.
6. Coalescing Filters: Collection efficiency of 99.9 percent retention of particles 0.3 micrometer and smaller.
7. Include automatic drain trap for each filter.

2.7 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean compressed-air equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for laboratory air applications, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.2 COMPRESSED-AIR EQUIPMENT INSTALLATION

A. General Requirements for Compressed-Air Equipment Installation:

1. Install compressed-air equipment to allow maximum headroom unless specific mounting heights are indicated.
2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces unless otherwise indicated.
3. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
4. Install equipment to allow right of way for piping installed at required slope.
5. Install the following devices on compressed-air equipment:
   a. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.

b. Pressure Regulators: Install downstream from air compressors, purification units, and filter assemblies.
c. Drain Valves: Install on aftercoolers, and receivers. Discharge condensate over nearest floor drain.

B. Nonmedical Laboratory Compressed-Air Equipment Installation:
1. Install compressed-air equipment on concrete inertia base, rectangular, 6”-tick for maximum 60” between base and isolated hangers of connected piping. Housed spring isolators with 3/4” spring deflection.
2. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
3. Comply with requirements for vibration isolation devices specified in Section 22 05 48 "Vibration Controls for Plumbing Piping and Equipment."

3.3 CONNECTIONS

A. Comply with requirements for water-supply piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for drain piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Comply with requirements for compressed-air piping specified in Section 22 15 13 "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Connect compressed-air piping to compressed-air equipment, accessories, and specialties with shutoff valve and union or flanged connection.

F. Connect water supply to compressed-air equipment that requires water. Include backflow preventer. Backflow preventers are specified in Section 22 11 19 "Domestic Water Piping Specialties."

3.4 IDENTIFICATION

A. Identify nonmedical laboratory compressed-air equipment system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 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. Check for lubricating oil in lubricated-type equipment.

3. Check belt drives for proper tension.
4. Verify that air-compressor inlet filters and piping are clear.
5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
7. Drain receiver tank(s).
8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
9. Test and adjust controls and safeties.

B. Prepare written report documenting testing procedures and results.

END OF SECTION

SECTION 23 00 00

HEATING VENTILATION AND AIR CONDITIONING

PART 1 - GENERAL

1.1 SCOPE

A. The work of Division 23 consists of providing labor, materials, products, and in performing all operations required for the complete operating installation of all mechanical systems in accordance with specifications, applicable drawings, terms, conditions of the contract and all applicable codes and ordinances governing the installation of the various mechanical systems. All work shall be fully correlated with the work of other crafts.

B. Each Contractor shall study the contract documents to determine the extent of work provided under this contract, as well as to ascertain the difficulty to be encountered in performing the work on the drawings and outlined hereinafter and in making connections to existing utilities, installing new equipment and systems and coordinating the work with the other Trades.

C. EXAMINATION OF SITE: The Contractor shall thoroughly examine site as to the conditions under which the Work is to be performed. The Contractor shall verify, at the site, all measurements affecting their work and shall be responsible for the correctness of same. No extra compensation will be allowed to the Contractor for expenses due to his neglect to examine or failure to discover conditions which affect his work. No extra compensation will be allowed on account of differences between actual dimensions and those indicated on the drawings.

1.2 REGULATORY REQUIREMENTS

A. Codes and Ordinances/Permit and Fees: Perform all work in accordance with all state and local codes and ordinances, the current edition of NFPA, latest city recognized Building and Mechanical Codes and all current supplements, revisions, and addendums thereto. The current city recognized edition of the Accessibility Standards of the Architectural Barriers Act and any other authorities having jurisdiction (AHJ) over the Work. Procure and pay for all permits, licenses, fees and charges, and give all notices necessary.

B. In case of conflict between the Contract Documents and requirements of any Code or authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern.

C. Should the Contractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances and Industry Standards, the Contractor shall bear all costs arising in correcting the deficiencies, as approved by the Architect.

1.3 INTENT

A. The drawings show general arrangements and the extent of the work. The drawings do not show, in minute detail, all features of the installation. Follow the drawings as closely as actual

construction will permit. All material and labor necessary to complete the work in accordance with the intent of the specifications and drawings shall be furnished by the Contractor without additional charge.

1.4 COORDINATION OF WORK

A. Each Contractor shall compare their drawings and specifications with those of other Trades. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, all Trades shall make proper provisions to avoid interferences.

B. Each Contractor shall coordinate the location of their systems so that all outside air intakes are located in such a way as to prevent cross-contamination with the plumbing vents and exhaust fans. Such a distance shall be not less than 10'-0" ft.

C. Locations of conduit, ducts, piping and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. Exact routing and location of systems shall be determined prior to fabrication or installation.

D. Offsets and changes of direction in all conduit, ducts and piping systems shall be made as required to maintain proper headroom and pitch of sloping lines.

1.5 SERVICEABILITY OF PRODUCTS

A. Furnish all products to provide the proper orientation of serviceable components to access space provided.

B. Coordinate installation of piping, ductwork, equipment, system components, and other products to allow proper service of all items requiring periodic maintenance or replacement.

C. Replace or relocate all products incorrectly ordered or installed to provide proper serviceability.

D. Provide access doors in ceilings, walls, floors, etc., for access to all serviceable or operable equipment in concealed spaces, such as but not limited to traps, valves, dampers automatic devices, etc.

1.6 SUBMITTALS

A. Prior to commencement of the Construction Administration Phase, Contractor shall obtain written direction from Owner regarding submittal literature and shop drawings record documentation and whether hard copies (physically organized and bound in a 3-ring binder folder) or electronic files (organized with sub-folders and placed on a USB drive and/or uploaded to an online portal as specified by Owner) for retention by Owner.

B. For Engineer review, submittals and shop drawings shall be provided in electronic PDF format. Newforma or other similar file sharing software/portals are preferred, however email transmission may be acceptable. Discuss with Engineer and Architect prior to the commencement of the Construction Administration Phase to establish the project specific protocol with all necessary parties.

C. Provide submittals for the equipment scheduled on the drawings. Provide submittals for all other materials, accessories and appurtenances as indicated within individual specifications. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents.

D. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the Contractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. The Contractor shall make all necessary changes in all affected related work provided under other Sections including location of rough-in connections by other Trades, conduit supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

1.7 RECORD AS-BUILT DRAWINGS

A. It will be the mechanical Contractor’s responsibility to mark up a clear set of As-Built mechanical drawings as the work progresses to show the deviations from the sealed construction mechanical drawings, including but not limited to the following.
   1. Re-routing of the HVAC supply air, return air, exhaust air and outside air ductwork.
   2. Re-routing of HVAC piping.
   3. Re-sizing of HVAC ductwork and piping.
   4. Exact location of all branch line shut-off valves.

B. Keep the marked-up As-Built drawings on site until completion of the project.

C. The General Contractor is to turn over the record As-Built drawings to the Owner upon completion of the project.

1.8 MATERIALS

A. Install new materials and equipment, free from defects. Use materials and equipment which bear the Underwriters' Laboratories, Inc. label where a U.L. standard has been established.

1.9 GUARANTEE

A. All equipment and work shall be guaranteed for a period of twelve (12) months after Owner acceptance. Any defects in equipment or workmanship shall be promptly repaired or replaced by the Contractor without additional expense to the Owner. The guarantee period of any part of the repaired item shall be extended for a period of one (1) year from the date of such repair or replacement.

1.10 COMPLETION

A. Upon completion of the mechanical installation, demonstrate to the Owner's satisfaction that the systems have been installed in a satisfactory manner in accordance with the plans and applicable codes. Show that all controls are operable and are properly adjusted in accordance with the requirements of the final systems balance, that all systems are properly balanced, that all equipment operates properly, that filters and strainers are clean, and that all components of all

systems are installed and adjusted for proper operation. Provide at minimum one (1) day of training for Owner's personnel in operation and maintenance of equipment, as scheduled by the Owner.

1.11 OPERATION AND MAINTENANCE MANUALS

A. Provide Operation and Maintenance Manuals for the equipment stated as specification section as requiring Operation and Maintenance Manuals. Utilize the Operation and Maintenance Manuals for training of Owner's personnel in operation and maintenance of systems and related equipment.

1.12 SUPPORTING DEVICES, CUTTING, AND PATCHING

A. Securely fasten all mechanical work to the structure to prevent hazard human life and limb, and to prevent damage to products of construction under all conditions of operation.

B. Do all sleeving, cutting and patching of rough construction for piping. All cutting, repairing and required structural reinforcing for installation of this Work shall be done in conformance with Architect's directions and any damage caused by cutting shall be repaired equal to original conditions. No cutting without Architect's approval.

C. Place any sleeves, chases, concrete inserts, anchor bolts, etc., before concrete is poured, and be responsible for correct location and installation of these items.

1.13 EQUIPMENT IDENTIFICATION

A. Provide an identification tag for all scheduled HVAC equipment. (Exception: Ceiling or wall mounted exhaust fans.)

B. The identification tags lettering and number for the mechanical equipment to match the lettering and number as shown on the schedule for the mechanical equipment. Refer to the schedule sheet in the construction drawings.

1.14 PRODUCT HANDLING

A. Use all means necessary to protect materials and equipment before, during and after installation and to protect installed work and materials of all other trades.

B. Deliver all materials to the job site in their original unopened containers with all labels intact and legible at time of use. Store in strict accordance with the manufacturer's recommendations as approved by the Architect.

C. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Dielectric fittings.
   3. HVAC demolition.
   4. Equipment installation requirements common to equipment sections.
   5. Concrete bases.
   6. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code – Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment with electrical characteristics that vary from the design documents may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are

appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS FOR PIPING

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

C. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12.

E. Solvent Cements for Joining Plastic Piping:
1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS FOR PIPING

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly per the following, whichever is greater: 250-psig minimum working pressure at 180 deg F, or design pressures and temperatures as dictated by design documents.

D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends per the following, whichever is greater: 300-psig minimum working pressure at 225 deg F, or design pressures and temperatures as dictated by design documents.

E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; per the following, whichever is greater: 300-psig minimum working pressure at 225 deg F, or design pressures and temperatures as dictated by design documents.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
   1. Piping to be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Ducts to be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to be Removed: Disconnect and cap services and remove equipment.
   6. Equipment to be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   7. Equipment to be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. 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.

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 to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal or greater than system operating pressure.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

M. Verify final equipment locations for roughing-in.

N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. 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.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. 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.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. 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 the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete”.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 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 600V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 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.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 110 deg F and at altitude of 3,300 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 Efficiency, 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: Re-greaseable, 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 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 Efficiency 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: Pre-lubricated, 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 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.
   3. Grout.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. 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.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, with plain ends and integral welded waterstop collar. For corrosive environments and exterior environments utilize anti-corrosion, anti-rust coating; for all other environments utilize zinc coating.

C. Galvanized-Steel Sheet Pipe Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

A. 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: Ethylene Propylene Diene Monomer (EPDM, a synthetic rubber used in a range of applications) or Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
   4. Pressure Plates: For standard applications utilize carbon steel. For exterior applications or applications within corrosive environments, utilize stainless steel.
   5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Description: Non-shrink, recommended for interior and exterior sealing openings in non-fire-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.

2.4 Note at Silicone Sealants are not allowed.

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. 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 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 sealants appropriate for size, depth, and location of joint.

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 NFPA.

3.2 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 Inner Diameter (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.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls Above Grade:
      a. Cast-iron pipe sleeves or steel-pipe sleeves. Use sleeve-seal fittings.
   2. Exterior Concrete Walls Below Grade:
      a. Cast-iron pipe sleeves with sleeve-seal system; or steel-pipe sleeves with sleeve-seal system. Use sleeve-seal fittings. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs-on-Grade:
      a. Cast-iron pipe sleeves with sleeve-seal system; or steel-pipe sleeves with sleeve-seal system. Use sleeve-seal fittings. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system
   4. Concrete Slabs Above Grade:
      a. Piping Smaller Than NPS 6: Steel-pipe sleeves`. Use sleeve-seal fittings.
      b. Piping NPS 6 and Larger: Steel-pipe sleeves.
   5. Interior Partitions:
      a. Piping Smaller Than NPS 6: Galvanized-steel pipe sleeves.
      b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

3.5 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 23 05 18

ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following are acceptable manufacturers:
   1. BassCraft Manufacturing.
   2. Dearborn Brass.
   3. Jones Stephens Corp.
   4. Keeney Manufacturing Company.
   5. Mid-America Fittings, Inc.
   6. ProFlo, a Ferguson Enterprise.
   7. Approved Equal by Engineer.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated or polished brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge or 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 Inner Diameter (ID) to closely fit around pipe, tube, and insulation of piping and with Outer Diameter (OD) that completely covers opening.
   1. Escutcheons for New Piping and Relocated Existing Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep pattern.
      b. Chrome-Plated Piping: One-piece steel or split-plate steel with polished, chrome-plated finish.
      c. Insulated Piping: One-piece steel.
      d. Insulated Piping: One-piece stamped steel or split-plate stamped steel.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel.
      f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel; or split-plate, stamped steel.
      g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel.
      h. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel; or split-plate, stamped steel.
   2. Escutcheons for Existing Piping to Remain:
      a. Chrome-Plated Piping: Split-plate, stamped steel.
      b. Insulated Piping: Split-plate, stamped steel.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with Inner Diameter (ID) to closely fit around pipe, tube, and insulation of piping and with Outer Diameter (OD) that completely covers opening.
   1. New Piping and Relocated Existing Piping: Split floor plate.
   2. Existing Piping to Remain: Split floor plate.

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 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Fastener systems.
   5. Equipment supports.

B. Related Requirements:
   1. Section 23 05 48.13 "Vibration Controls for HVAC" for vibration isolation devices.
   2. Section 23 31 13 "Metal Ducts"

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
   1. Trapeze pipe hangers.
   2. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of trapeze hangers.
   2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: As defined in Section 01 40 00 "Quality Requirements," engage a qualified professional engineer as specified 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: Pre-galvanized, 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.

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 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psi (or greater) minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi (or greater) 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.

2.5 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. Use stainless steel for exterior applications and for applications in corrosive environments; use zinc-coated steel for all other applications.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MATERIALS

A. Aluminum: ASTM B221 or ASTM B221M.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Non-staining, 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 00 "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 operating loads and future static operating loads, within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lbs or 20% excess of operating loads, whichever is greater.

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. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. 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.

G. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal 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.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. 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.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. 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.

O. 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.

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 of copper-plated pipe hangers and copper attachments is acceptable for copper piping and tubing only.

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 uninsulated 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 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 non-insulated, stationary pipes NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of uninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of uninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of uninsulated, stationary pipes NPS 1/2 to NPS 8
   10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of uninsulated, stationary pipes NPS 3/8 to NPS 8.
   11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of uninsulated, 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 unnecessary.
   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 unnecessary.

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-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 48.13

VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fiberglass isolation pads.
2. Pipe-riser resilient supports.
3. Elastomeric hangers.
4. Spring hangers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each vibration isolation device.
1. Include design calculations for selecting vibration isolators.

PART 2 - PRODUCTS

2.1 FIBERGLASS ISOLATION PADS

A. Fiberglass Isolation Pads:
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. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Vibration Eliminator Co., Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: high-density matrix pre-compressed fiberglass with elastomeric coating.
5. Surface Pattern: Smooth pattern.
6. Retain subparagraph below if galvanized-steel baseplates are adhered to the isolation pad to facilitate load distribution.
7. Load-bearing metal plates adhered to pads.

2.2 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

2.3 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
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. Ace Mountings Co., Inc.
   b. Isolation Technology, Inc.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.
   e. Vibration Eliminator Co., Inc.
   f. Vibration Mountings & Controls, Inc.
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.4 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

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. Ace Mountings Co., Inc.
   b. Isolation Technology, Inc.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.
   e. Vibration Eliminator Co., Inc.
   f. Vibration Mountings & Controls, Inc.

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. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
b. Top housing with attachment and leveling bolt.

2.5 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
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. Ace Mountings Co., Inc.
b. Kinetics Noise Control, Inc.
c. Mason Industries, Inc.
d. Novia; A Division of C&P.
e. Vibration Eliminator Co., Inc.
f. Vibration Isolation.
g. Vibration Mountings & Controls, Inc.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 - EXECUTION

3.1 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

E. Provide vibration isolation per schedule below for buildings with 20ft and less span. Isolator deflections and stiffness provided for most applications, however, the exact stiffness and deflection are outside of the natural resonating frequency range of the rotating system should be confirmed for the specific equipment installed.

EQUIPMENT TYPE	HORSE POWER / SP	ISOLATOR TYPE	DEFLECTION
Air Handling Unit	<10 HP	Open Spring or Spring Hanger Directly attached	1”
CU / VRF on Grade	All	Fiberglass (Kinetics KIP) or Rubber Neoprene Pads	1/4"
CU / VRF on Roof	All	House spring isolator	3/4"
Fans < 22 IN. Diam	Any	Spring Hanger Directly attached	3/4"
Fans < 22 IN. Diam	< 2 IN WC SP	Open Spring with spring base or Spring Hangers with rubber bushings	1.5"
Air Compressor Vertical (see Plumbing and Division 22)	All	Concrete inertia base, rectangular. 6”-thick for maximum 60” between base and isolated hangers of connected piping. Housed spring isolators.	3/4"

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.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Material and Thickness: Brass 0.032-inch or aluminum 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Owner to advise.
3. Background Color: Owner to advise.
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 up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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.

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) and 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: Owner to advise.

C. Background Color: Owner to advise.

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-quarters 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 according to ASME A13.1.

B. Pretensioned Pipe Labels: Pre-coiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include 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: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.

B. Letter Color: Owner to advise.

C. Background Color: Owner to advise.

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-quarters 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. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

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 Section 09 91 23 "Interior Painting".

B. 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. 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 and on both sides of 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:
1. Refrigerant Piping: Black letters on a safety-orange background, or white letters on a safety-purple background, or black letters on a safety-white background, or white letters on a safety-gray background, or white letters on a safety-black background. Owner to

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.

1.2 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.

F. TDH: Total dynamic head.

1.3 ACTION SUBMITTALS

A. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section "System Balancing" (latest version as recognized by Authority Having Jurisdiction).

1.4 INFORMATIONAL SUBMITTALS

A. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

B. Certified TAB reports.

1.5 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 as a TAB technician.

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 as a TAB technician.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

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, but not limited to, 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 supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan 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 heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine operating safety interlocks and controls on HVAC equipment.

L. 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 strategies and step-by-step procedures for balancing the systems.

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. Duct systems are complete with AHUs installed.
      b. Volume, smoke, and fire dampers are open and functional.
      c. Clean filters are installed.
      d. Fans are operating, free of vibration, and rotating in correct direction.
      e. Automatic temperature-control systems are operational.
      f. Ceilings are installed.
      g. Windows and doors are installed.
      h. 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 according to the procedures contained in one of the following: AABC's "National Standards for Total System Balance"; ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems"; or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, and equipment cabinets 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. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation," and Section 23 07 19 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, fan-speed-control levers, 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).

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" 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.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts."

3.5 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 not suitable 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 Record Documents 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 Owner (and Commissioning Agent/Authority if applicable) 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.

3.6 TOLERANCES

A. Set HVAC system's airflow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.7 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, 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. Face and bypass damper settings at coils.
      e. Fan drive settings including settings and percentage of maximum pitch diameter.
      f. Inlet vane settings for variable-air-volume systems.
      g. Settings for supply-air, static-pressure controller.
      h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outdoor, supply, return, and exhaust airflows.
   2. Duct, outlet, and inlet sizes.
   3. Balancing stations.
   4. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.

f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   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.
3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in CFM.
   b. Total system static pressure in inches wg.
   c. Fan RPM.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Outdoor airflow in CFM.
   i. Return airflow in CFM.
   j. Outdoor-air damper position.
   k. Return-air damper position.
   l. Vortex damper position.

F. 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.

G. 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 rpm.
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.

H. 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.

I. 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 rpm.
      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 RPM.
      d. Discharge static pressure in inches wg.
      e. Suction static pressure in inches wg.

J. Round, Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
   1. Report Data:
      a. System 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.

3.8 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager (and Commissioning Authority/Agent, if applicable).

B. Construction Manager (and Commissioning Authority/Agent, if applicable) shall be given the opportunity to randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day. TAB specialist shall provide written confirmation from Construction Manager (and from Commissioning Authority/Agent, if applicable) if random testing was declined.

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 testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, 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.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, Owner, design professional, and/or Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 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 exhaust between isolation damper and penetration of building exterior.
   6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Related Sections:
   1. Section 23 07 19 "HVAC Piping Insulation."
   2. Section 23 31 13 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   3. Thermal and acoustical insulation will need to meet emissions requirements and have no added formaldehyde binders. For submittal documentation shall indicate such.

C. 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.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct 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 as follows:, Type I, Type II with factory-applied vinyl jacket, Type III with factory-applied FSK jacket, or Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. For operating temperatures higher than 250 deg F, use blanket insulation, and use ASTM C1290 types as follows: Type I for insulation without jackets, Type II for insulation with vinyl jackets, and Type III for insulation with FSK or FSP jackets.

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. For operating temperatures higher than 250 deg F, use board insulation with FSK jacketing for ductwork and plenum applications.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.
   1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
   2. Service Temperature Range: Minus 20 to plus 180 deg F, or to the temperature range of the medium, whichever is more extreme.
   3. Color: White.

2.5 SEALANTS

A. FSK and 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.

B. ASJ Flashing Sealants and Vinyl 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.

2.6 FACTORY-APPLIED JACKETS

A. Coordinate types of factory-applied jacket insulation materials selected and types of factory-applied jackets indicated in insulation system schedules.

B. 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.

4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

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.

2.9 SECUREMENTS

A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, 3/4 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:
   1. 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, 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.
   2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened 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, nylon sheet, 0.030-inch thick by 1-1/2 inches in diameter.
      b. Spindle: Nylon, 0.106-inch diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
      c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. 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, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-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. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 CORNER ANGLES

A. Aluminum Corner Angles: 0.040-inch thick, minimum 1 inch by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 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. Cover circumferential joints and longitudinal joints with 3-inch wide strips and reinforcing mesh. 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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
   5. Make use of vapor retardant mastics and fiberglass mesh strips.

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.

3.3 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 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.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. 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 00 "Firestopping" for firestopping and fire-resistive joint sealers.

3.4 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 50 percent coverage of duct and plenum surfaces, or per manufacturer’s recommendations, whichever is greater.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. 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 over-compress 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 tape matching insulation facing.

4. 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.
   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.
5. 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.
6. 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.
7. 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.

3.5 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 00 "Firestopping".

3.6 FINISHES

A. Insulation with ASJ 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. Finish coat material shall be interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.7 FIELD QUALITY CONTROL

A. Contractor shall install all products per manufacturer's guidelines with a standard of care that is industry standard.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   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 exhaust between isolation damper and penetration of building exterior.
   6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:
   1. Fibrous-glass ducts.
   2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   3. Factory-insulated flexible ducts.
   4. Factory-insulated plenums and casings.
   5. Flexible connectors.
   6. Vibration-control devices.
   7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density. Minimum R-6 thermal resistance.

B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density. Minimum R-6 thermal resistance.

C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density. Minimum R-6 thermal resistance.

D. Concealed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 1.0-lb/cu. ft. nominal density.

E. Exposed, Supply-Air Duct and Plenum Insulation: Double Wall pre-insulated duct system.

F. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches thick and 1.5-lb/cu. ft. nominal density.

G. Exposed, Outdoor-Air Duct and Plenum Insulation: Double Wall pre-insulated duct system.

H. Exposed, Exhaust-Air Duct and Plenum Insulation: 2 inches thick and 1.5-lb/cu. ft. nominal density.

3.10 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. Provide Factory or field applied ASJ jacketing and mastic.

D. Ducts and Plenums, Exposed:
   1. Aluminum, Smooth: 0.020 inch thick.
   2. Double Wall Duct per 233113 - Metal Ducts

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulation for HVAC piping systems.

B. Related Sections:
1. Section 230713 "Duct Insulation" for duct insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material test reports.

C. Field quality-control reports.

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 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.

1.6 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.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.

1. Preformed Pipe Insulation: Type II, Class 1, without jacket.
2. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ or ASJ-SSL 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.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.

H. 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 or with factory-applied ASJ-SSL.
2. 850 deg F.
3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type I, Grade 1, for tubular materials and with Type II, Grade 1, for sheet materials.

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. 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: 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.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

E. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

2.3 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

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: 0 to plus 180 deg F.
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier

listing on DOD QPD - Qualified Products Database.
4. Color: White.

C. 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: 0 to plus 180 deg F.
3. Color: White.

2.4 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. ASJ Flashing Sealants:
1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: White.

2.5 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.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

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 or 2.5-mil- thick polysurlyn.
    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. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

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. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
    1. Width: 3 inches.
    2. Thickness: 6.5 mils.
    3. Adhesion: 90 ounces force/inch in width.
    4. Elongation: 2 percent.
    5. Tensile Strength: 40 lbf/inch in width.
    6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

A. Bands:
    1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch

wide with wing seal or closed 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 or closed 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 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. 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.

3.2 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 2 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams, 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.

3.3 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 Section 078400 "Firestopping" for 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 Section 0784100 "Firestopping."

3.4 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 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.

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.

3.5 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.

3.6 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.

3.7 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.

E. 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 polyolefin 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.

F. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of polyolefin 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.

G. Insulation Installation on Valves and Pipe Specialties:
   1. Install cut sections of polyolefin pipe and sheet 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.
   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 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 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.

C. Where PVC jackets are indicated and for horizontal applications, 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.

D. 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.

3.9 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.

3.10 FIELD QUALITY CONTROL

A. Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. 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 three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 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. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 3/4 inch thick.
b. Polyolefin: 3/4 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 1 inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 2 inches thick.

D. Refrigerant Liquid Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 1 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 2 inches thick.

C. Refrigerant Liquid Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 1 inch thick.

3.14 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. None.

D. Piping, Exposed:
1. Aluminum 20mil.

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. Painted Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.032 inch thick.

D. Piping, Exposed:
1. Painted Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.032 inch thick.

END OF SECTION

SECTION 23 09 23.12

CONTROL DAMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control dampers and actuators for DDC systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal:
1. Schedule and design calculations for control dampers and actuators, including the following.
a. Flow at project design and minimum flow conditions.
b. Face velocity at project design and minimum airflow conditions.
c. Pressure drop across damper at project design and minimum airflow conditions.
d. AMCA 500D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
e. Maximum close-off pressure.
f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

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. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Selection Criteria:
1. Control dampers shall be suitable for operation at following conditions:

a. Supply Air: 4 IN. WG. at 54°F DB.
b. Return Air: 4 IN. WG. at 78°F DB.
c. Outdoor Air: 4 IN. WG. at 100°F DB.
d. Economizer Air: 4 IN. WG. at 100°F DB.
e. Exhaust Air: 4 IN. WG. at 85°F DB.

2. Fail positions shall be as indicated on the drawings. If not otherwise indicated, fail positions shall be as follows:
   a. Supply Air: Last position.
   b. Return Air: Open.
   c. Outdoor Air: Close.
   d. Economizer Air: Close.
   e. Exhaust Air: Last position.
3. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.

2.2 RECTANGULAR CONTROL DAMPERS

A. 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 assemble multiple damper sections to provide a single damper assembly of size required by the application.
3. 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. Ruskin Company.
   b. Greenheck
   c. Honeywell
   d. Siemens

B. Rectangular Dampers with Aluminum Airfoil Blades:
1. Performance:
   a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
   b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
   c. Velocity: Up to 6000 fpm.
   d. Temperature: Minus 40 to plus 185 deg F.
   e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
   f. Damper shall have AMCA seal for both air leakage and air performance.
2. Construction:
   a. Frame:
      1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.06 inch thick.

2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
3) Width not less than 5 inches.

b. Blades:
1) Hollow, airfoil, extruded aluminum.
2) Parallel or opposed blade configuration as required by application.
3) Material: ASTM B211, Alloy 6063 T5 aluminum, 0.07 inch thick.
4) Width not to exceed 6 inches.
5) Length as required by close-off pressure, not to exceed 48 inches.

c. Seals:
1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
2) Jambs: Stainless steel, compression type.

d. Axles: 0.5-inchdiameter plated steel, mechanically attached to blades.

e. Bearings:
1) Molded synthetic or stainless-steel sleeve mounted in frame.
2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:
1) Concealed in frame.
2) Constructed of aluminum and plated steel.
3) Hardware: Stainless steel.

g. Transition:
1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches.
4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.

2.3 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.

C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.

D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

G. Provide mounting hardware and linkages for connecting actuator to damper.

H. Select actuators to fail in desired position in the event of a power failure.

I. Actuator Fail Positions: See Drawings. Where not otherwise indicated provide as below:
   1. Exhaust Air: Open.
   2. Outdoor Air: Close.
   3. Supply Air: Last position.
   4. Return Air: Open.

2.4 ELECTRIC AND ELECTRONIC ACTUATORS

A. Type: Motor operated, with or without gears, electric and electronic.

B. Voltage:
   1. Provide voltage as indicated on drawings, if not otherwise indicated provide 120 V actuators for spring return applications. Provide 24 V actuator for all other applications.
   2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
   3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.

C. Construction:
   1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
   2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
   3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

D. Field Adjustment:
   1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
   2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Modulating Actuators:
   1. Capable of stopping at all points across full range, and starting in either direction from any point in range.

2. Control Input Signal:
    a. For terminal units and other level two controllers: Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
    b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
    c. Programmable Multi-Function:
        1) Control input, position feedback, and running time shall be factory or field programmable.
        2) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
        3) Service data, including at a minimum, number of hours powered and number of hours in motion.

G. Position Feedback:
1. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Where indicated, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

H. Fail-Safe:
1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.

I. Integral Overload Protection:
1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

J. Damper Attachment:
1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

K. Temperature and Humidity:
1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

L. Enclosure:
1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with a heater and controller where required by application.

M. Stroke Time:
1. Operate damper from fully closed to fully open within 60 seconds.
2. Operate damper from fully open to fully closed within 60 seconds.
3. Move damper to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

N. Sound:
1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 CONTROL-DAMPER APPLICATIONS

A. Control Dampers:

B. Select from damper types indicated in "Control Dampers" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered. Dampers shall operate in accordance with the SMACNA recommended construction class and velocity for the application.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.

C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Seal penetrations made in fire-rated and acoustically rated assemblies.

E. Fastening Hardware:
1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.

2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

F. Install products in locations that are accessible and that will 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.

3.3 ELECTRIC 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 CONTROL DAMPERS

A. Install smooth transitions, not exceeding 15 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.

B. Clearance:
1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

C. Service Access:
1. Dampers and actuators shall be accessible for visual inspection and service.
2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."

D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

E. Attach actuator(s) to damper drive shaft.

F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

G. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

H. 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."

I. Install engraved phenolic nameplate with damper identification on damper.

3.5 CHECKOUT PROCEDURES

A. Control-Damper Checkout:
1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Verify that control dampers are installed correctly for flow direction.
4. Verify that proper blade alignment, either parallel or opposed, has been provided.
5. Verify that damper frame attachment is properly secured and sealed.
6. Verify that damper actuator and linkage attachment are secure.
7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
8. Verify that damper blade travel is unobstructed.

3.6 ADJUSTMENT, CALIBRATION, AND TESTING:

A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

C. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION

SECTION 23 09 23.20

GAS DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gas detection system, monitors and notification appliances.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. For each type of gas monitor indicated, include sensing range in ppm, temperature and humidity range, alarm outputs, display range, furnished specialties, installation requirements, and electric power requirement.

B. Shop Drawings:
   1. Air-Sampling Tubing: Size, routing, and termination including elevation above finished floor.
   2. Wiring Diagrams: Power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 Warranty

A. Two year part and labor warranty.

PART 2 - PRODUCTS

2.1 SINGLE OR DUAL ZONE HAZARDOUS GAS MONITOR

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.
   2. Federal Signal Corporation

B. Gas Monitor: Dual zone, electronic gas detection panel.
   1. Basis of Design product: Armstrong AMC-1AD2
   2. Enclosure
      a. Material: ASA 61 gray enamel 16-gauge steel
      b. Rating: NEMA 4X

3. Power: 120 VAC, 1ph 60hz.
4. Operating temperatures: 0 deg F to 100 deg F
5. Relay contacts: 4 DPDT, 10A with 250 VAC resolution.
6. Indicators (per zone)
    a. Zones: 2
    b. Red LED: Alarm
    c. Yellow LED: Warning
    d. Green LED: Run, Fault, Off
    e. Gas detection modules (per zone): 8
7. Features:
    a. Alarm disable during warmup
    b. System test switch
    c. Minimum run timer
    d. Activation delays: Five minutes to warning and/or alarm set points.
    e. 95 dBa audio alarm and warning. Alarm set points.
    f. Latching relays with manual reset.
    g. Manually activate relays (purge exhaust) through monitor.

C. Description: Sensor shall be factory tested, calibrated, and certified to continuously monitor specific gas concentration and shall be capable of indicating, alarming and enabling exhaust systems. System shall be capable of up to eight (8) detection modules per zone.

D. Combustible Gas
1. Gas Types:
    a. Liquified Petroleum Gas
    b. Compressed Natural Gas
2. Basis of design product: Armstrong AMC-1225
3. Range: 0% to 50% LEL
4. Standard trip points: Minimum two.
    a. Level 1: 20% LEL
    b. Level 2: 40% LEL
5. Operating temperature: 0 deg F to 100 deg F
6. Operating Humidity: 15% RH to 90% RH
7. Coverage Radius: 25 feet.

E. Noxious Gas
1. Gas Types:
    a. CO (Carbon Monoxide)
    b. NO_x (Nitrous Oxides)
2. Basis of design product: Armstrong AMC-1222
3. Range:
    a. CO: 0ppm to 100ppm
    b. NOx: 0pmm to 3ppm
4. Standard trip points: Minimum two.
    a. CO: Level 1: 25 PPM
    b. CO: Level 2: 100 PPM
    c. NOx: Level 1: 25 PPM
    d. CO Level 2: 100 PPM

5. Operating temperature: 0 deg F to 100 deg F
6. Operating Humidity: 15% RH to 90% RH
7. Coverage Radius: 50ft

F. Input/Output Features:
1. Maximum Power Input: 120-V ac, 60 Hz, 75 W.
2. Number of Sampling modules: up to 8 per zone.
3. Number of sampling zones: up to two zones
4. LED indicators (per zone)

    a. RED LED: Alarm
    b. YELLOW LED: Warning
    c. GREEN LED: Run, Fault, and Off indication
5. Relays: Four double pole double throw 10A 250 VAC contacts
6. System test switch
7. Minimum run timer
8. 95 dBa audio alarm with warning and alarm set points
9. Hinged door
10. Latching relays with manual reset.
11. Audible Output: Minimum 75 dB at 10 feet.
12. Visible Output: Strobe light.
13. Sensor Analog Output: 0- to 10-V dc into 2k ohms, or 4- to 20-mA into 1k ohms.
14. Enclosure: NEMA 250, Type 1, with locking quarter-turn latch and key.

2.2 MONITOR ALARM SEQUENCE

A. Detection Level 1: Sustained LEVEL 1 levels detected per sensor setting. Illuminate yellow light on gas detection system panel. Close relay to energize purge exhaust system. Refer to mechanical plan sequence of operation.

B. Detection Level 2: Illuminate red light on gas detection system. Sound alarm horns and cycle blue strobe lights. Ventilation system shall continue to operate to purge air from room. Refer to mechanical plan sequence of operation. Provide manual reset for this detection level.

C. Sensor Fault/Trouble: Illuminate trouble light upon fault detection.

2.3 NOTIFICATION APPLIANCES

A. Horns: Comply with UL 464; electric-vibrating-polarized type, listed by a qualified testing agency with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.
1. General purpose industrial rated siren.
2. Metal housing
3. Rated for 108 dB.
4. Include mounting kit for wall mount applications.
5. Basis of design product: Federal Signal A-120 Electric Siren

B. Visible Alarm Devices: Comply with UL 1971; blue polycarbonate lens mounted on an aluminum faceplate. The words "GAS DETECTION" printed in minimum 1/2-inch-high letters on the lens. Rated light output is 75 candela.
   1. General purpose “electraflash” strobe warning light.
   2. Color: Blue lens, strobing.
   3. Include mounting kit for wall mount applications.
   4. Enclosure: NEMA 3R
   5. Basis of design product: Federal Signal Electraflash 141ST-120A

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install warning signs, labels, and nameplates to identify detection devices according to Section 23 05 53 "Identification for HVAC Piping and Equipment."

B. Audible Alarm-Indicating Devices: Install at each entry door to equipment room, and position not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

C. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn at each entry door to equipment room, and position at least 6 inches below the ceiling.

D. Install monitor panel at 48” above finished floor.

3.2 INSTALLATION SCHEDULE

A. Install monitors and sensors for 100% coverage according to manufacturer listed coverage areas. Mount to wall, columns and ceilings according to manufacturer requirements and Division 26 specifications for raceways and boxes.

B. Installation of specific equipment shall comply as follows:
   1. Liquid Petroleum Gas
      a. Wall mounted at 18” above finished floor
      b. PVC enclosure
   2. Compressed Natural Gas
      a. Ceiling mounted within 12” of highest point of structure
      b. PVC enclosure
   3. Nitrous Oxides
      a. Wall mounted at 60” above finished floor
      b. PVC enclosure
   4. Carbon Monoxide
      a. Wall mounted at 60” above finished floor
      b. PVC enclosure
   5. Gas Detection Control panel
      a. Wall mounted 48” AFF to highest operable button.

C. Horn

1. Wall mount 120” aff.
2. 24VAC or 120V single phase power wired though gas monitor relay.
3. Operate horn upon Level 2 Alarm

D. Strobe
1. Wall mount 120” aff.
2. 24VAC or 120V single phase power wired though gas monitor relay.
3. Operate horn upon Level 2 Alarm
4. Color: Blue strobe

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
1. Inspect field-assembled components, equipment installation, and electrical connections for compliance with requirements.
2. Test and adjust controls and safeties.
3. 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. Repair or replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 23 10 10

FUEL SYSTEM GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SUMMARY:

A. Work in this section includes furnishing all materials, labor and supervision necessary for the construction of the new fuel storage and dispensing facility. The work shall include all tanks, pumps, pipe, fittings, valves, filters, meters, dispensers, appurtenances and activities as specified herein and shown on the drawings. All testing, inspection and flushing shall be provided as specified to provide a complete and operational system.

B. All permits and licenses that are required by governing authorities for the performance of work shall be procured and paid for by the Contractor.

C. The work will be completed during normal operating hours and conditions unless otherwise specified. Staging of construction activities is required.

1.2 REFERENCES:

A. Refer to each individual section in this division for a list of applicable references from each of the following organizations:
1. American Petroleum Institute (API):
2. National Fire Protection Association (NFPA):
3. Underwriters Laboratories (UL):
4. American Society of Mechanical Engineers (ASME):
5. American Society for Testing and Materials (ASTM):
6. Factory Mutual Engineering Division (FM):
7. Industrial Risk Insurance (IRI):
8. Military Specifications (Mil):
9. Petroleum Equipment Industry (PEI):

1.3 DEFINITIONS:

A. "Piping" includes in addition to pipe, all fittings, valves, sleeves, hangers, and other supports and accessories related to such piping.

B. The words "furnish and install", "provide", "furnish", and "install" are used to mean the Contractor shall furnish and completely install the system, service, equipment, or material named along with other associated devices, equipment, material, wiring, piping, etc. as required. System shall be a complete operating installation, and shall conform to the codes, standards and guidelines applicable to this type of project.

C. It is the intent of the specifications and drawings to call for finished work, tested and ready for operation.
   1. All apparatus, appliances, materials, or work not shown on drawings but mentioned in specifications, or vice versa, and/or all incidental accessories necessary to make work complete and ready for operation, even though not specified or shown on drawings, shall be furnished and installed without increase in contract price.
   2. Should there be discrepancies or questions of intent, refer matter to the Engineer in writing for a decision before ordering any equipment or materials or before starting any related work.

1.4 COMPLIANCE SUBMITTALS:

A. Compliance submittals shall be processed in accordance with Section 01 33 00 Submittal Procedures. Submittals are required for all material specified. If material or equipment is shown on the drawings to be included in this project but is not specified, the Contractor shall bring this to the immediate attention of the Engineer. Submittals are required for all material and equipment incorporated into this project whether specified or not.

B. The Contractor's attention is called to the Engineer's review of Compliance Submittals. This review shall be completed and the submittal returned to the Contractor before starting installation or fabrication.

C. The Contractor's submission of a compliance submittal constitutes that he has both verified and coordinated all dimensional data, quantities, field conditions, catalog data, and compliance with the specification or he assumes full responsibility for doing so.

D. Compliance Submittals shall include all components and units of fabrication for the fueling system specified in the following sections:
   23 11 16 System 1 – Facility Fuel Piping - Unleaded
   23 11 19 System 2 – Facility Fuel Piping – Diesel
   23 10 10 Fuel System General Provisions

E. Submittal Formats are as follows:
   1. Product Information: Submit manufacturer's data sheets identifying equipment size, descriptions, materials, ratings, etc.
   2. Drawings: Submit drawings which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.
   3. Instructions: Preprinted material describing installation of a product, system or material, including special notices and material safety data sheet, if any, concerning impedance, hazards and safety precautions.
   4. Statements: A document required of the Contractor, or through the Contractor, from a supplier, installer, manufacture, or other lower tier Contractor. The purpose of which is to confirm the quality or orderly progression of a portion of the work by

documenting procedures, acceptability of methods or personnel, qualifications or other verifications of quality.

5. Reports: Reports of inspections or tests, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used shall be identified and test results shall be recorded.
6. Certificates: Statement signed by an official authorized to certify on behalf of the manufacturer of a product, system or material, attesting that the product, system or material meets specified requirements. The statement must be dated after the award of this contract, must state the Contractor's name and address, must name the project and location, and must list the specific requirements that are beingcertified.
7. Records: Documentation to record compliance with technical or administrative requirements.
8. Submittal Review Action:
    a. A – Reviewed: Indicates information is sufficient in detail and adequately organized for performance of the review. Material conforms to the intended functional requirements of the contract documents and is approved for fabrication, procurement and incorporation into the project as submitted.
    b. B – Reviewed as Noted: Indicates information submitted is sufficient in detail and adequately organized for performance of the review. Material conforms to the intended functional requirements of the contract documents and is approved for fabrication, procurement and incorporation into the project as noted. Submitted item is not considered by the reviewer to be a critical element of the project and/or noted comments are minimal in quantity and complexity so that no additional review is necessary. Copies with limited marks are acceptable to all parties as permanent record documents.
    c. C – Revise as Noted/Resubmit: Indicates information submitted is sufficient in detail and adequately organized for performance of the review. Item generally conforms to the intended functional requirements of the contract documents and is approved for fabrication, procurement and incorporation into the project as noted. Submitted item is not considered by the reviewer to be a critical element of the project but noted comments are sufficient in quantity or complexity so that resubmission is appropriate to assure responsive action, or copies with marks are not acceptable to all parties as permanent record documents. Item must be resubmitted responsive to the reviewers' comments.
    d. D – Rejected/Resubmit as Specified: Indicates information submitted may not be sufficient in detail or adequately organized for performance of the review. Item may appear to conform to the intended functional requirements of the contract documents but certain elements do not or lack sufficient information to be evaluated. Item is not approved for fabrication, procurement or incorporation into the project. Submitted item is considered by the reviewer to be a critical element of the project and/or noted comments are sufficient in quantity or complexity so that

resubmission is necessary to assure acceptable responsive action and conformance with the contract documents. Item must be resubmitted responsive to the reviewers' comments.

e. F – No Action Required: Indicates item has been submitted for informational purposes only and no action response or comments are needed by the reviewer. Item should be retained in project files.

f. G – Submittal Not Requested/Returned Without Review: Indicates submission of item was not required by the contract documents and is not part of the reviewers contractual project scope. Item is being returned without review or comment.

1.5 QUALITY ASSURANCE:

A. Materials and equipment shall be new unless approved for use by TxDOT, and shall bear manufacture's name, model number, and other identification marking.

B. Materials and equipment shall be standard product of manufacturer regularly engaged in the production of required type of material or equipment for at least 5 years (unless specifically exempted by Engineer) and shall be manufacturer's latest design having published properties.

C. If more than one unit of the same type of equipment is required, (i.e., control valves, manual valves, etc.) they shall be products of a single manufacturer.

D. The Contractor is responsible for protecting all equipment and material from loss or damage until the system is completed and accepted by the Owner.

E. The Contractor shall be responsible for coordinating with the manufacturer for installation of the equipment furnished. The Contractor shall be responsible for warranty work required and shall coordinate with the manufacturer of the equipment to accomplish warranty work including any labor and additional cost for such warranty work. The equipment manufacturer shall provide the Contractor with installation manuals and instructions. The Contractor shall receive and install this equipment for a complete furnished and installed installation including all accessories as specified within these specifications and as shown on drawings.

F. The Contractor shall check equipment delivered to job site by the equipment supplier against approved Compliance Submittals or other required documentation. The Contractor shall report all discrepancies, shortages, or lack of data to the Owner and equipment supplier for adjustments within one week after equipment is received. If such report is not made within one week, it shall be assumed no discrepancies, shortages, or lack of data has been found.

G. Contractor shall provide the following for all equipment furnished:
   1. All rough-ins for equipment and accessories.
   2. Installation of loose trim provided with equipment by the equipment supplier.

3. Furnish and install all piping connections, valves, unions, control valves, drains, and other accessories as indicated on the plans and as specified here within these documents.

H. The products of specific manufacturers have been used as the basis of design. Any changes to the structure, piping, controls, and electrical connections that result from the use of other manufacturers shall be coordinated with all other trades by the Contractor and approved in writing on letterhead by the Engineer before the ordering of the equipment from the manufacturer. Any resultant modifications required shall be performed without incurring additions to the contract price.

I. The bid shall be based only on products specified. The Contractor shall verify delivery dates for timeliness before submitting his bid. Desired product substitutions shall be brought to the Engineer's attention prior to bidding. No consideration shall be given to substitutions after bids are received.

J. Unless this Contractor states in writing at the time of pricing any and all exclusions to these specifications or drawings in his bid proposal, this Contractor shall furnish and install at the job site the equipment, material, labor and services as specified herein and shown on the drawings for the amount of his bid.

1.6 DRAWINGS:

A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the contract. Drawings are not to be scaled. All drawings and details shall be examined and coordinated by the Contractor to establish exact location of piping and equipment. Where conflicts occur, the Contractor shall inform the Engineer immediately.

B. The Contractor shall follow all contract drawings in laying out work and shall check shop drawings of other trades to verify spaces in which work will be installed.

1.7 MAINTENANCE MANUALS:

A. In addition to the requirements specified in the General Conditions, at the project's completion, the Contractor shall submit a complete system Operating and Maintenance Manual (O&M). The manual at a minimum shall include the following:

1. The manual shall be composed of typed instruction sheets with large drawing sheets (not reduced) folded in with reinforced margin. It shall have a post binder system so that the sheets can be easily substituted and shall have a hardcover.
2. The manual shall be organized into systems and shall contain the manufacturer's complete detailed operating and maintenance instructions with data sheets for each piece of equipment furnished under this project.

3. Include a spare parts list for each major piece of equipment furnished for the project including but not limited to:

a. Pumps
b. Control Valves
c. Filters
d. Tanks
e. Manual Valves
f. Meters

4. Provide a comprehensive list of maintenance procedures for preventative maintenance and troubleshooting; repair and reassembly, aligning and adjusting, and disassembly.

1.8 NAMEPLATES:

A. All major equipment items shall have a permanent, stamped metal, nameplate. The nameplate shall be permanently attached to the equipment in a manner such that it does not hinder the operation of the equipment. All nameplates shall be protected from overspray during field painting operations. Nameplates shall generally include the applicable items in the following list:

1. Manufacturer's Size and Type
2. Serial Number
3. Design Capacity
4. Design Pressure
5. Design Temperature
6. Code Conformance

1.9 CODE REQUIREMENTS AND PERMITS:

A. All work indicated on the contract drawings and herein specified shall conform with all applicable codes or laws of the State of Texas and any other governmental bodies having jurisdiction and shall be installed to the satisfaction of the inspecting authority.

B. Any deviations from the contract documents or specifications required for conformance with the applicable codes or laws shall be made without change in contract price, but not until such deviations have been brought to the attention of, and approved in writing, by the Engineer.

C. The applicable codes and laws shall govern the minimum requirements only. Where the drawings or specifications call for materials, construction limitations, or other similar requirements in excess of the code requirements, the drawings and specifications shall be followed.

D. The Contractor shall obtain and pay for permits and licenses, and shall pay all fees and taxes and give all notices bearing on the conduct of the work as drawn and specified. Certificates of compliance, approval, or acceptance from all authorities having jurisdiction over the work shall be obtained and delivered to the Owner.

E. All work indicated on the drawings and herein specified shall conform with all applicable standards of the National Fire Protection Association, American Petroleum Institute, American National Standards Institute and American Society for Testing and Materials.

F. All work indicated on the drawings, and herein specified, or tasks required in the performance of the work but not specifically indicated in the drawing or specifications, shall conform with the applicable requirements of the Occupational Safety and Health Administration (OSHA) as provided in 29 CFR. Applicable requirements include, but are not limited to, Part 1910 – Occupational Safety and Health Standards and Part 1926 – Safety and Health Regulations for Construction.

G. All equipment, materials, and specialties shall be installed and connected in accordance with the best engineering practice and standards for this type of work. Unless otherwise specified or shown on the drawings, the recommendations and instructions of the manufacturer shall be followed for installing the work.

H. The Contractor shall promptly notify the Engineer in writing, of any instances in the specifications or on the drawings that are in conflict with any of the aforementioned authorities so that any required changes shall be adjusted before the contract is awarded. If the Contractor performs any work contrary to such laws, rules, regulations or recommendations, without notice, he shall bear all cost arising therefrom.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION:

A. Contractor shall be responsible for the safety and protection from loss or damage of all equipment and material received until all the work under this contract is complete and the Contractor has received final acceptance. Protect all equipment and material during storage and prior to start-up, which shall include the coverings of all openings, protection against rust and other damage, etc.

B. Contractor shall ensure that all equipment installed as part of this contract shall be properly aligned, adjusted and lubricated before final acceptance.

C. Contractor shall spot paint all equipment where the shop paint has been damaged or flaked off.

D. Furnish all bolts, studs, nuts and gaskets for makeup of all connections to the equipment and replace all gaskets, bolts and fasteners damaged or as directed during the flushing process.

E. All connections to equipment shall be made with socket welds and unions or flanges where specified. Piping larger than 2 inches shall be flanged or welded unless otherwise specified.

3.2 REQUIREMENTS:

A. Mechanical and electrical designs are based on the requirements for the specified manufacturers listed in the equipment specification. Conduit sizes are selected on the basis of specified equipment. Increased manufacturers requirements necessitating piping changes, additional power conductors, controls, foundations, etc., or any changes required to accommodate any alternate or substitute manufacturer's equipment, other than as shown on drawings shall be provided without any increase in contract price by Contractor.

B. Manufacturers, where specifically called for, must provide factory tests, unit installation observations, unit start-up and tests, etc., as specified. Signed reports shall be submitted to the Engineer upon completion of these services. Subletting of these services will not be permitted. Compliance Submittals shall be accompanied with a letter of certification by the manufacturer that the specified services shall be provided. Failure to do so shall be cause to reject the Compliance Submittals.

C. The contract drawings are in part schematic, intended to convey the scope of work and indicate the general layout, design, and arrangement. The Contractor shall follow these drawings in the layout of his work and shall consult general construction drawings, electrical drawings, and all other drawings for this project. Contractor shall verify all existing site conditions to determine all conditions affecting the work shown or specified. The contract drawings are not to be scaled and the Contractor shall verify areas in which the work is to be installed.

D. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum space conditions at all points. Where space conditions appear inadequate, Engineer shall be notified before proceeding with installation.

E. All work shall be performed by trained personnel of the particular trade involved and shall be done in neat and workmanlike manner as approved by the Engineer.
   1. Work shall be performed in cooperation with other trades and scheduled to allow timely and efficient completion of project.
   2. Furnish other trades advance information on locations and sizes of frames, boxes, sleeves and openings needed for work. Also furnish information and shop drawings necessary to permit other trades affected to install their work properly without delay.
   3. Where there is evidence that work of one trade will interfere with work of other trades, all trades shall assist in working out space conditions to make satisfactory adjustments.

F. Work installed before coordinating with other trades causing interference with work of such other trades shall be changed to correct such condition without increase in contract price and as directed by Engineer.

G. Where specific details and dimensions are not shown on the drawings, the Contractor shall take measurements and make layouts as required for the proper installation of the

work and for coordination with all other work on the project. In case of any discrepancies between the drawings and the specifications, it shall be assumed by the signing of the Contract that the higher cost (if any difference in costs) is included in the contract price. The Contractor shall perform the work in accordance with the drawings or with the specifications, as determined and approved by the Engineer.

H. The Contractor shall be responsible for a scheduled sequence in performing the work so that it will not interfere with the Owner's operation. Before any work is started, the Contractor shall consult with the Engineer and Owner and arrange a satisfactory schedule.

1. Make temporary alterations as required to execute work so that all operations and services are maintained with the minimum possible interruption.
2. Temporary shut-downs shall be segregated and shall be of the shortest possible duration. All facilities shall be kept in continuous operation unless Owner grants specific written permission to the contrary.

I. It is the responsibility of the Contractor to monitor the construction area for the presence of flammable vapors and to assure the proper construction methods and equipment is used if hazardous conditions exist.

3.3 EXISTING CONDITIONS:

A. Each bidder shall inspect the site as required for knowledge of existing conditions. Failure to obtain such knowledge shall not relieve the successful bidder of the responsibility to meet existing conditions in performing the work under the contract.

B. Where new work cannot be installed without changes in existing plant, facility, or systems or where it is indicated on drawings to re-work an existing installation, this contract shall include alterations to existing work as required to install new work. Additions to the contract cost will not be allowed because of the Contractor's failure to inspect existing conditions.

C. Existing conditions indicated on the drawings are taken from the best information available on previous contract drawings and from visual site inspection. They are not to be construed as "As Built" conditions, but are to indicate the intent of this work. It shall be the responsibility of the Contractor to verify all existing conditions at the project site and to perform the work as required to meet the existing conditions and the intent of this work indicated.

D. Unless specified otherwise, all existing material and equipment shown or required to be removed from existing construction and not shown to be reused or turned over to the Owner shall become the property of the Contractor and shall be promptly removed from the site.

E. Any existing material or equipment which is to be reused or is to remain in place and which is damaged by this Contractor in performing the contract work shall be repaired to the satisfaction of the Owner or shall be replaced with new equipment and material.

3.4 STORING MATERIALS:

A. Unless otherwise arranged for by the Contractor, buildings of the Owner shall not be used for Contractor storage or job office purposes. Open or exposed space for storage of material and location of temporary job facilities will be allocated to the Contractor. The Contractor, at his own expense, shall provide any temporary structures such as trailers and sheds, as may be required for this purpose.

3.5 CUTTING AND PATCHING:

A. The responsibility for the cutting of existing masonry and concrete which is required for the installation of new work shall be by the Contractor. The Contractor shall coordinate with the Owner before any cutting and obtain approval from the Engineer and the Owner prior to any cutting.

B. Cutting shall be done with extreme care and in such a manner that the strength of the structure will not be endangered. Wherever possible, openings in concrete or masonry construction shall be by concrete saw or rotary core drill. Openings in any construction shall be cut the minimum size required for the installation of the work.

C. Where openings or holes are cut in existing construction and the cutting breaks existing electrical circuitry, control circuitry, communications, conduit, or wiring, then it shall be the responsibility of the Contractor to have the circuitry, conduit, and rewiring re- routed as required and as approved by the Owner. Temporary completion shall be provided where necessary before the permanent re-routing and completion work is finished. All costs for this work shall be the responsibility of the Contractor and no additions will be allowed to the contract price.

D. Where existing work is removed from openings in existing construction and the opening is not to be reused for new work, the opening shall be filled and patched to match existing adjacent construction.

3.6 BASES, FOUNDATIONS, SUPPORTS, AND ATTACHMENTS:

A. The Contractor shall provide all structural steel, concrete, and materials necessary to properly support and anchor equipment and lines provided under this contract.

B. All equipment and materials shall be securely attached in an approved manner. Attachments shall be of a strong and durable nature and suitable for the service required.

C. Concrete bases shall be provided where shown on the drawings. Equipment which is to be grouted in place shall be grouted with non-shrink grout.

D. All equipment shall be mounted, aligned, adjusted, and serviced in accordance with manufacturer's recommendations before system testing and final acceptance of the system.

3.7 ELECTRICAL COORDINATION:

A. All electrical products and their installation shall conform unless otherwise specifically noted, to applicable standards of the National Electrical Manufacturers Association, NFPA 70, and shall also be listed by Underwriter's Laboratories, Inc. and/or other agencies, as required.

3.8 TESTING LABORATORY SERVICES:

A. The Contractor shall secure the services of an independent testing laboratory approved by the Engineer and Owner to perform all testing, witnessing and certification of materials. This applies to coating integrity, fuel acceptability, pressure tests and weld examinations.

B. The cost for all laboratory services will be the responsibility of the Contractor.

C. The laboratory shall:
1. Cooperate with the Engineer, Owner and Contractor; and provide qualified personnel promptly on notice.

2. Perform specified inspections, sampling and testing of materials and methods of construction:
   a. Comply with specified standards; ASTM, other recognized authorities and as specified.
   b. Ascertain compliance with requirements of contract documents.
3. Promptly notify the Engineer, Owner and Contractor of irregularities or deficiencies of work, which are observed during performance of services.

4. Promptly submit 2 copies of reports of inspections and test to the Engineer including:
   a. Date Issued
   b. Project Title and Number
   c. Testing Laboratory Name and Address
   d. Name and Signature of Inspector

e. Date of Inspection or Sampling
f. Record of Temperature and Weather
g. Date of Test
h. Identification of Product and Specification Section
i. Location in Project
j. Type of Inspection or Test
k. Observations Regarding Compliance with Contract Documents

5. Perform additional pre-approved services as required by the Engineer, Owner and Contractor.
6. The laboratory is not authorized to:
   a. Release, revoke, alter, or enlarge on, requirements of contract documents
   b. Approve or accept any portion of work
   c. Perform any duties of the Contractor

D. The Contractor shall:
1. Coordinate laboratory services, cooperate with laboratory personnel, provide access to project and to manufacturer's operations.
2. Furnish to laboratory preliminary representative samples of materials to be tested, in required quantities.
3. Furnish labor and facilities:
   a. To provide access to work to be tested
   b. To obtain and handle samples at the site
   c. To facilitate inspections and tests
   d. For laboratory's use for storage of test samples
4. Arrange with laboratory and pay for pre-approved additional samples and tests required for Contractor's convenience.
5. The Owner shall reserve the right to request the Contractor to obtain the services of a separate, equally qualified independent testing laboratory, to perform additional inspections, sampling and testing required when initial test indicate work does not comply with contract documents. The Contractor shall pay the costs of such retesting.

3.9 WARRANTY BY CONTRACTOR:

A. Warrant all systems, equipment, materials and components installed under these specifications for a period of not less than one (1) year from time of beneficial use of the facility and systems by the Owner.

END OF SECTION

SECTION 23 10 20

INSPECTION, TESTING AND FLUSHING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Inspection of all fabrication, assembly and installation performed to construct the new fuel storage and dispensing system.

B. Testing of all fuel system controls, operations, equipment and systems.

C. Flushing of all piping and equipment within the system

1.2 RELATED DOCUMENTS:

A. Laboratory listing services for specific methods of construction, fabrication and assemblies shall be as specified in Section 15231.(Fuel system provisions)

B. American National Standards Institute (ANSI)

C. American Petroleum Institute (API)

1.3 QUALITY ASSURANCE:

A. All tests shall be performed in accordance with the applicable Related Documents.

B. All Work, as specified herein, shall be observed by the Engineer's Representative.

1.4 SUBMITTALS:

A. The Contractor shall develop, submit for review and approval, written plans for all testing and flushing.

B. The testing and flushing plans shall include but, not be limited to the following:
1. Identification of system or component
2. Date and time to be performed
3. Method and Description of Event
4. Coordination of approvals
5. Event results
6. Conclusions and recommendations

C. The Contractor shall submit for examination by the Engineer's Representative, qualifications of the personnel to be utilized in testing and flushing prior to proceeding.

D. All inspections, testing and flushing tasks shall be recorded and certified by the Contractor and shall include the signatures of the personnel involved.

PART 2 - MATERIALS

2.1 EQUIPMENT:

A. The Contractor shall provide all necessary devices to test and flush the complete system. Items shall include but, not be limited to the following:
1. Electronic holiday detectors
2. Air compressors
3. Pumps
4. Pressure and temperature recorders
5. Flow rate indicators and recorders

B. The Contractor shall provide any temporary piping, connectors, hoses, pumps, filters, tanker vehicles and operators to test and flush all segments of the system.

PART 3 - EXECUTION

3.1 GENERAL:

A. The Contractor shall be responsible for the operation of all permanent and temporary equipment and systems and conduct all performance tests in a safe and effective manner. The Contractor shall provide all the necessary equipment, tools, media and labor required for the proper performance of the tests.

B. The Owner shall be responsible for the procurement and delivery of all fuel required for on-site testing and flushing. The fuels to be purchased shall be regular unleaded fuel and diesel fuel. Water shall not be used for the testing and flushing of any fuel piping or components.

C. Upon completion of system testing and flushing, the fuel shall be tested to determine cleanliness and specification qualities. The fuel that is determined acceptable for use, shall be retained in storage. The Contractor will receive a credit for this fuel on the final payment of this Contract. In the event the fuel is unacceptable for use, it must be removed from the system and site at the Contractor's expense.

3.2 INSPECTION OF PIPE WELDING

A. Radiographic Testing of welds is not required unless failures are noted in pneumatic testing.

3.3 INSPECTION OF PIPE COATINGS:

A. The Contractor shall inspect all exterior pipe and joint coatings with a Holiday Tester to locate any damage to the protective coatings during the course of construction.

B. This element of testing shall take place after all welding has been completed.

C. The inspection shall be performed by using an approved tester at voltage recommended by the coating manufacturer.

3.4 TESTING OF FUEL PIPING:

A. The Contractor shall test all segments of the fuel piping after fabrication and assembly is essentially complete.

B. The initial test shall be a pneumatic pressure test in accordance with ANSI B31.3. The test shall be performed using dry compressed air at a pressure of 50 psig for 4 hours.

C. In the event a failure is observed, the Contractor shall locate, repair and retest. If the pneumatic test is successful, the Contractor shall begin preparation for hydrostatic testing.

D. In preparation for hydrostatic testing, the Contractor shall remove all control valves, meters, and other equipment which is not rated by the manufacturer for the test pressure. Test pressure shall be 150% of operating pressure but not less than100 psig. Piping spools and blind flanges shall be provided and installed by the Contractor.

E. Prior to hydrostatic testing the Contractor shall carefully fill the fuel system piping with the proper grade of fuel. During the filling process care should be taken to properly vent all high points to disperse all air pockets.

F. The hydrostatic testing shall be in accordance with ANSI B31.3 and shall include a two-step process. The initial step will be to gradually bring system pressure up to 75 psig and inspect all joints, components and connections. The second step will be to gradually bring system pressure up to test pressure and recheck all joints, components, and connections.

G. The actual test shall be held for four hours.

H. During the testing period, if a leak develops, the Contractor shall abort the test, repair the defect and restart the test.

3.5 SYSTEM FLUSHING:

A. It will be the Contractor’s responsibility to provide the Owner with a complete and functional fuel system. One important aspect of this accomplishment is the interior cleanliness of the piping system. Therefore, this becomes a critical part of the Contractor’s responsibility.

B. Prior to starting the flushing process, the Contractor shall develop a detailed procedure, sequence and schedule for approval by the Engineer.

C. The Contractor shall be responsible for providing and installing all temporary manifolds, connections and devices to facilitate the flushing process.

D. When possible, temporary piping assemblies will be used to form a closed loop piping system for recirculation. When not possible fuel will be flushed into tank trucks provided by the Contractor.

E. Components such as control valves, strainer baskets, and control devices shall not be in place during flushing.

F. The desired velocity rate for flushing is 10 feet per second to satisfy ATA 103 QA Standards.

G. One initial flushing at minimum is required to ensure piping cleanliness. If this cannot be accomplished after a single flush, then a second flushing will be required. The system being flushed must be displaced with clean fuel prior to taking second flushing.

H. Contractor shall flush low point drain(s) and sump(s) prior to, during, and after each flushing procedure to remove any sediment that may accumulate in the low point. Additionally, the contractor shall vent all high point vents prior to each flushing procedure.

I. Acceptance Specifications:

1. Visual - All fuel samples must be clear and bright. Other visual clues must be observed and acted upon accordingly, i.e.; feel, color, odor, etc. This test shall be performed with a minimum of 1 gallon of Regular Unleaded fuel or Diesel fuel, depending upon the service of the system.
2. Perform a membrane test per ASTM D3830. A minimum of 1 gallon of Regular Unleaded/Diesel Fuel (depending upon the service) shall be used for this test. Visually assess the membrane and compare it with a color rating booklet. The color shall be a maximum of A2, B2, or G2 with a particulate contamination not exceeding the B scale on the shell particle assessment guide. Flushing shall continue and the membrane test repeated, until a sample is obtained which meets these requirements. Note: If color rating exceeds the above limits or is in dispute, a matched weight gravimetric rating not to exceed 0.5 mg/gal shall govern.

J. Final Acceptance:

1. It shall be the responsibility of the Owner to have final decision on system cleanliness and acceptance before fuel servicing is permitted.

K. After flushing has been completed and approved, the Manufacturer shall remove all temporary cross connections, spool pieces, etc., and install control valves, metering elements, strainer baskets, etc. The Manufacturer shall also be responsible for replacing all filter media and cleaning the interior of filter vessels after flushing has been completed so that the entire system assembly may be received in a new and clean condition. Additionally, the tank shall be inspected visually following the flush. The

Manufacturer shall be responsible for cleaning the tank if deem required by the Owner.

3.6 SYSTEM TESTING:

A. After all individual devices and components have been tested and after the piping system has been tested and flushed, the Contractor shall perform overall operational system tests. It shall be the responsibility of the Contractor to debug, test and verify operation of the installed systems in complete conformance to itemized functions of each system as identified throughout Section 16100

B. The Contractor shall be responsible for establishing all testing procedures and shall demonstrate operation of each completed "system" to the Resident Manager, Operator and the Owner. Each demonstration may be videotaped by the Owner at his discretion. At a minimum, the following tests must be completed:

1. Tank Low Level Alarm
   a. Position valves to transfer fuel out of the tank. Start the fueling pump and pump sufficient fuel out of the tank to allow the low level alarm to activate and to stop the fueling pump. Verify low level alarm lights are illuminated and horn is activated and silenced.
2. Tank High Level Alarm
   a. Position valves to transfer fuel in to the tank. Start the fueling pump and pump sufficient fuel into the tank to allow the high level alarm to annunciate. Verify the level is at or below 90% of tank volume. Verify high level alarm lights are illuminated and horn is activated and silenced.
3. Tank High High Level shut off valve
   a. Position valves to transfer fuel in to tank. Start the pump to transfer fuel into the tank. Verify the tank high level shutoff pilot actuates the high level shut off valve and the valve closes at or before 93% of tank volume at 10-15 gpm flowrate.
4. Truck Unloading Operation
   a. Perform a truck unloading operation at the pump skid and verify the operation of the skid, opening speed of control valves, and emergency shutdown. Verify and record flow rates throughout the unloading operation.
5. Truck Loading Operation
   a. N/A
6. Emergency Shutdown
   a. With the fueling pump circulating fuel through the system, test each "Emergency Stop" push button station to verify that the pump stops.
   b. When dispensing fuel, test each "Emergency Stop" push button station to verify that the pump stops.
7. Tank Level Indicator Adjustments
   a. During the filling operation of the tank, adjust and calibrate the tank level indicators including the final setting of the low level and high level alarms.

8. Dispenser
   a. Complete testing of the dispenser, suction pump, hose reel, card reader, and solenoid valves shall be completed to ensure proper operation of the system.
9. Anti-siphon valves
   a. Verify proper operation the anti-siphon valves, both mechanical and solenoid valves on the system to ensure proper operation.

END OF SECTION

SECTION 23 10 30

FUEL SYSTEM CONTROLS

PART 1 - GENERAL

1.1 SUMMARY:

A. The work of this Section includes the final design layout and furnishing and installing of a Control System for the New Fueling System complete with equipment provided under other Sections, as shown on the drawings and as specified. Equipment shall include, but not be limited to:
   1. Emergency Fuel Shut off Stations
   2. Selector Switches
   3. Push Button Stations
   4. Alarm Horns and Other Distributed Annunciation Devices
   5. Modular, Multi-Tank Gauging System
   6. Interstitial Leak Sensors
   7. External Alarm Horn

B. Provide all labor, equipment and material necessary to integrate new and existing equipment into a new, complete and fully operational control system as indicated on the Drawings and as specified in the Contract Documents.

C. Design indicated on drawings is schematic in nature to allow flexibility and non-proprietary indication of functional requirements. Provide final system design with point-to-point wiring layouts and requirement, system coordination and implementation and final performance verification to ensure that the system functions as intended.

D. The control system shall include all control devices, sensors, actuators, valves, transmitters, control panels, color coded control wiring, meters, gauges, and tubing as specified and as required to fulfill the intent of these specifications. Coordinate all this work with the mechanical, electrical and fueling system specifications.

E. Raceway requirements, supports, and other applicable requirements governing the installation of control conductors shall conform to Division 26 unless expressly modified and specified in this Section. All internal wiring shall be supplied ready for field connections at terminal blocks.

F. This Section also identifies requirements for:
   1. Tank Level Transmitters
   2. Interstitial Leak Sensors
   3. Alarm Devices
   4. Emergency Fuel Shutoff (EFSO) System
   5. Integration of EFSO system and tank level systems

6. Credit Card Reader/Fuel Management System

G. All control and instrumentation work and control panels provided under this Division shall be accomplished, to the fullest extent, under the responsible direction of the qualified system provided as described in Section 23 10 20 .(FS General Provisions)

1.2 APPLICABLE STANDARDS:

A. Comply with the requirements of the referenced standards identified herein.
1. INSTRUMENT SOCIETY OF AMERICA: Comply with the Instrumentation symbols and Identification standard ISA-S5.1
2. UNDERWRITER LABORATORIES: Provide electrical components and assemblies - whenever possible - which have been UL listed and shall be labeled.
3. ANSI/NFPA 70: National Electric Code (NEC)
4. NEMA: Comply with the National Electrical Manufacturer's Association's "Industrial Controls and Systems" standard.

B. Comply with all standards which are applicable to the work of this Section, those listed in these specifications and in particular, those listed in Division 23 Sections 23 10 10, 23 10 20, 23 11 16, and 23 11 19.

1.3 PROJECT RECORD DOCUMENTATION:

A. The Contractor shall, at system turnover, provide revised shop drawings of the control related equipment supplied under Division 01. The Contractor's drawings and shop drawings/cut sheets shall reflect the actual installation and shall represent operating sequences that are a part of the control systems functions at the completion and acceptance of the project by the Owner.

B. Submit four copies of the revised documents and each shall be stamped "As-Built" with a date assigned to the stamp. Provide four copies of CD rom with PDF format files of each drawing.

C. Submit a comprehensive report of the check-out and debugging of the completed system at turnover.

D. At the completion of the project, submit a recommended spare parts list for the overall project and submit a corresponding unit cost breakdown.

1.4 SUBMITTALS:

A. Not used

1.5 OPERATION AND MAINTENANCE DATA:

A. The finished manual to be provided by the Contractor at the completion of the project

shall be in a single or matched set of three ring binders with clear labeling along the spine to indicate the nature of the document and to allow the document to be stored in a standard bookcase. The data within the binder shall be segregated according to the material provided and shall be tabbed and labeled accordingly. The data shall be comprehensive and shall provide the Owner with enough information to provide a foundation for operating the system and for maintaining the system's operation in the long term.

B. Submit the document in two copies. One copy will be retained by the fueling manager and one copy will be retained by the Engineer.

C. Submit the following specific documents and diagrams - these are minimum requirements - the Contractor shall provide comprehensive documentation as noted in these specifications.
   1. A written document of the programs provided as part of the ATG system for the operator use in learning and operating the system. Include keyboard and final graphic screen illustrations to help orient the user to the operation of the system. Provide set- by-step procedures for daily and regular operator functions corresponding to operation of the fuel system.
   2. Comprehensive operation and maintenance manuals for the system and elements which make up the system.
   3. Recommended spare parts list.
   4. Copies of drawings showing internal and external wiring for the system.
   5. Copies of the original Bill of Material.

PART 2 - MATERIALS

2.1 GENERAL:

A. Provide products suitable in the application intended - that is, a fuel system for combustible and flammable fluids in a critical application where failure of the control system could seriously compromise the use of the overall system. Provide a system that is reliable and complimentary to the nature of the application.

2.2 CONTROL PANEL NAMEPLATES:

A. Fabricate nameplates using laminated phenolic sheeting. Laminates shall be white for the core and black for the finished overlay. Each laminate shall be 1/16 inch nominal. Edges shall be beveled at 45 degrees. Lettering shall be 1/4 inch and shall expose the white core.

2.3 MODULAR, MULTI-TANK GAUGING SYSTEM:

A. Level Gauge/interstitial monitor
   1. The tank(s) shall be equipped with a continuous level gauge and an interstitial monitor as indicated. The level transmitters and leak detection probes shall be

connected to a controller and console. The controller and console shall be mounted as indicated.

2. Controller:
   a. The controller shall be microprocessor-based, and shall be designed and constructed with modular architecture easily permitting either factory or field upgrades and servicing. Configuration and set-up data shall be maintained in non-volatile memory having a minimum fifty (50) year data retention without requiring power of any kind. Replacement or substitution of any controller plug-in card shall not require system re-configuration. Real-Time clock and non-critical log data, such as inventory, delivery, alarm, theft, error, and leak reports shall be maintained in battery backed non-volatile memory with a minimum data retention of from 5 years in the event of a power outage. System shall include digital display for viewing tank information and LED indicators for the alarm conditions.
   b. System shall have the capability to continuously monitor up to two (2) dual- float magnetostrictive in-tank level probes and eight (8) leak sensors. Leak and point-level sensor inputs shall support a means to detect sensor open-circuit and short-circuit wiring faults as a standard feature when used in conjunction with fault-reporting sensors. The RS-232 serial port shall be standard for communications with a local PC computer. Provide 12-channel Analog Output card to provide 0-20ma/4-20ma/0-24ma/0-1ma signals for tank-related real-time data. System shall operate on switch 115 VAC (+/- 10%), 60 Hz. Maximum power consumption shall be 20 watts.
3. Console:
   a. The console shall be housed in a lockable surface mounted NEMA 4X enclosure. The console shall include microprocessor board, probe/sensor card, power supply, control I/O and communications interfaces. Front panel display shall include audible and visual alarms, and user-friendly membrane pushbutton controls. The display shall be nine digit, seven segment, quasi- alphanumeric sunlight readable LED type, with LED alarm annunciators for five (5) alarm conditions; leak, three (3) tank product set points, and one (1) bottom water set point per tank. LED alarm lights shall be visible from at least 60 feet and the seven-segment display data shall be readable from no less than twenty (20) feet. Displays shall include product gross or net, percent of capacity, 90/95/100% ullage, product and water level, product temperature, and product type. Console shall have provisions for accepting two (2) non- hazardous Relay I/O expansion cards. Provide one 4 input / 4 relay output card; user-programmable for activation by the following event types; Theft, Power Fail Recovery, System Error, Tank Leak, Product Set points, Water Set points, Leak/Point Level Sensors, Contact Closure inputs and Line Leak. The system shall be supplied with three industrial quality front panel sealed membrane push buttons labeled MODE, TANK SELECT, and TEST. Membrane push buttons shall be utilized in conjunction with the

display screen to select tank quantities, view, set, acknowledge alarm conditions; set/review configuration data, initiate system tests, view inventory and other logged data. Provide RS-232 serial port as standard for two-way communications with a future PC computer. Microsoft Windows XP thru 10 compatible software shall be provided to retrieve and display current tank statuses, remotely read, write and initialize system setup, clock, and configuration data.

4. Tank Gauging Probe:
   a. Probe shall be designed for AST applications and shall have performance characteristics permitting continuous gauging accuracy of +/- 0.0005 inches for product, +/- 0.001 for water and +/- 0.001 degrees F for (relative) temperature. Probe shall contain an array of at least five (5) temperature sensors along its length for accurate volumetric temperature compensation. Probe to console communication shall employ digital transmission techniques carried over standard, readily available two-conductor, shielded cable, with a maximum cable length restriction of no less than 4000 feet. Probe operating temperature and pressure shall be -40 to +175 degrees F and 150 PSIG respectively. Probes shall be supplied with 316SS product float, 316SS water float, six (6) foot leader cable with watertight connector, and centering rings for riser mounted applications. Probe shall be UL/CSA approved for use in Class I, Division I, Group C & D hazardous locations.
   b. Probe shall be provided with a Probe Riser Mounting Kit.
5. Interstitial Monitor Leak Sensors:
   a. Steel tank double-wall sensor shall be a 3-wire, solid state, electronic leak sensor utilizing electro-optic technology to detect the presence of liquids in secondary containment applications. Sensor shall be constructed of PTFE and Epoxy. Sensor shall be a 3-wire type consisting of a magnetic, electro-optic sensor encased within a ¾ inch diameter outer housing and supplied with twenty-five (25) feet of 3-conductor #22 AWG gage Teflon wire. Sensor shall be rated to 50 PSIG at 160F with an accuracy of 1/2-inch of liquid. Sensors shall be provided with wiring fault detection. Sensors shall be mounted in a direct mounting kit provided by the manufacturer with the express intent of installing in a tank nozzle.

2.4 FIELD MOUNTED CONTROL PANELS:

A. Utilize new pump control panels, making the necessary changes as specified in the drawings.

B. The panel enclosures shall be NEMA 4X

C. Electrical System:
   1. Wiring:
      a. Provide all wiring necessary for equipment specified for installation,

including internal wiring for all space equipment and all future connections as required.

b. Terminal blocks for all external connections except shielded cables.

c. NEC type THHN/MTW wire, rated 105 degrees at 600 volts. DC signal wiring shall be as specified in Division 26.

d. Wire shall be sized for load being serviced; No. 14 AWG minimum unless otherwise indicated.

2. Wiring shall be color coded.

3. Wire Markers:

a. Hot stamped type, Brady Ty-grip, Electrovert slip on Type Z, or Floy Tag FT200C wire markers sized for snug fit for wire size.

b. Identify both ends of wire with the same unique wire number.

c. Wire numbers shall be assigned where specific designations are not indicated.

4. Wiring Methods:

a. Main groups of wires routed in plastic nonflammage wiring duct with removable covers.

b. Smaller groups of wire cabled and secured with nylon cable clamps and ties or plastic spiral wraps.

c. Instrument dc signal wiring shall be routed in separate ducts or groups from ac power and control wiring.

d. Wire with no splices and all connections made on equipment studs or terminal blocks. Except for shielded cables, bring all wiring requiring field connections out to terminal blocks conveniently grouped to receive the external cables. Wire all space contacts on switches and relays to terminal blocks.

e. Provide extra flexible hinge wire in areas subject to flexing such as hinged panels, doors, etc.

f. Equipment Connections:

1) All connections made with insulated locking spade lug terminals except where devices specified are available only with solder-type terminals.

2) Terminals installed as recommended by manufacturer.

g. Solder Connections: Soldering iron used not to exceed 100W.

h. Provide terminal blocks for all external connections.

i. Provide copper internal ground bus. Connect all internal grounds required to the bus.

2.5 EMERGENCY FUEL SHUTOFF (EFSO) STATIONS:

A. The EFSO stations shall consist of signage, supporting rack structure, grounding to rack and a push button station. The EFSO stations shall also consist of hardware and accessories.

B. The EFSO push button shall be a factory sealed, explosion-proof (NEMA 7), NEMA 3R

(weatherproof), jumbo red mushroom head, momentary contact, push button device with keyed reset; Crouse Hinds Series EFS/EDS. Provide a legend plate for each device indicating "EMERGENCY FUEL SHUT OFF SWITCH". Furnish mounting bracket, box and accessories as required for mounting to rack support structure.

C. Provide signage at each EFSO station and where indicated. The sign shall be 0.80-inch thick aluminum manufactured by Best Manufacturing Company or equal by STANCO or Accent Signage Systems, Inc. The sign shall feature screen printed copy on engineer grade reflective vinyl sheeting suitable for exterior use. The lettering shall be typestyle: Eurostyle Bold Extended, color ; red, and 2" high. The background color shall be white. The sign shall read: first line - EMERGENCY, second line - FUEL SHUTOFF. Mount the sign a minimum 7 feet above grade. The sign nominal size shall be 18" x 9". Mount sign above pushbutton and securely fasten to support rack with stainless steel hardware.

2.6 CONTROL RELAYS:

A. Plug-in type general purpose control relays with coil voltage and number of contacts as required to re-establish automatic operation of the existing controls and as indicated on Drawings. Where the number of contacts required exceeds the number available on a single relay, provide cascaded relays. Provide with plug-in relay socket with numbered wire terminals corresponding to the relay pin numbers. Contacts shall be rated for a minimum 10 amps at 125 VAC.

2.7 RESUSE OF EXISTING ASSETWORKS FUEL MANAGEMENT SYSTEM

A. Install a complete system to allow self service fueling of vehicle . Manufacturer shall be regularly engaged in the manufacturing of such devices for the industry and shall have a minimum of 5-years experience.

B. Provide a fuel island controller that is self standing console. The controller shall be capable of controlling two separate, yet simultaneous dispensing operations. Provide two 50 amp solid state relays capable of controlling two hose positions. The controller shall be capable of receiving pulses from the dispenser meter register.

C. The controller shall be provided with both a credit card access device and a Smart card access device. The credit card access must be capable of reading standard credit cards.

D. The controller shall have a sunlight readable LCD display and a keyboard for input of desired quantity and desired product type.

E. Provide a receipt printer on the console. Receipt printer shall be capable of printing a receipt of the transaction along with the Facility Name, date, and time.

F. Provide a data logger in the controller to electronically capture transactions on a removal SD card.

2.8 EXTERIOR ALARM HORN

A. Weather resistant.

B. Sound output adjustable at horn enclosure.

C. Construction: Copper-free (less than 0.3 of 1% copper) aluminum.

D. Single projection type

E. Loudness rating at 10 feet, 100 decibels minimum

F. Nominal voltage: 120Vac.

G. Federal or approved equal

H. Mount to Electrical Rack and connect to tank gauging console.

PART 3 - EXECUTION

3.1 INSTALLATION**:**

A. Install a complete control system as specified, indicated, or required for proper and safe operation of the New Fueling Facility. All materials and workmanship shall comply with these specifications as a minimum. However, the Contractor shall conform to manufacturer's recommendations. Should a conflict arise between the specifications and the manufacturer's recommendations, the Contractor shall identify same as soon as the conflict arises and notify the Owner's representative in writing.

B. The Contractor shall provide all openings in floors, walls, roofs, and other structures which are necessary but not necessarily shown on the drawings for complete equipment installation. Include openings through floors for future cables to connect to spaces provided in equipment for future breakers and controls as they apply to the future fourth tank.

C. The Contractor shall place Silicone RTV in concrete walls, floor and roof slabs after installation of raceway and conduit serving the control system. In addition, the Contractor shall seal all holes provided for future connections and raceways.

D. All floor-mounted equipment shall be installed level utilizing shims, and anchors adjoining floors or structures with bolts or cinch anchors.

E. All internal and external connections that are necessary to allow the system to function as specified shall be provided, tested and turned over to the Owner by the Contractor.

3.2 FUEL SYSTEM SEQUENCE OF OPERATION:

A. The fuel system shall contain the operator interface devices and accept the input signals from field devices as indicated on the drawings.

B. The multi-tank gauging system shall sound the alarm horn for any alarm. Low Level, High Level, and Leak Detection Alarms have to be reset from the gauging system console.

C. The primary control function of the multi-tank gauging system controller is to accept Low and High Level signals, and interstitial leak signals for all regular unleaded and diesel tanks. Upon high level or low level alarm, both summary permissive contacts shall open to disallow the operation of any skid-mounted fuel system pumps. Key bypass switches shall be provided to override these alarm conditions and allow the fuel pumps to operate without the resetting of the alarms. The bypass switches must be returned to "normal" prior to being able to remove the key. Each switch shall be keyed identical.

D. Pushing any one of the Emergency Fuel Shut-off push buttons (EFSO) installed under this contract will cause a shunt trip of the Main Circuit Breaker which will shut down power to the entire fueling facility.

3.3 FIELD QUALITY CONTROL:

A. The Contractor shall provide the services of an experienced service engineer to verify proper installation, calibrate instrumentation, assist in start-up and testing and instruct the Owner and Operator of the New Fueling System. The Contractor is responsible for training the individuals effectively - not just being on-site. Provide a plan for training, a schedule and a recommended list of attendees.

B. The Contractor shall also provide the on-site attendance of representatives from the System Supplier when judged necessary by the Owner's representative, for the purposes of coordination, schedule and other such requirements. Costs associated with attendance on-site shall not increase the contract sum.

C. All trips to the site shall be coordinated with the government's representative and the Engineer.

D. Provide four copies of all individual video tapes (DVD format) of all training sessions.

3.4 EXAMINATION:

A. The Contractor shall review all existing conditions and shall familiarize himself with all existing systems such as telephone and power systems prior to initiating shop drawings. The Contractor shall physically inspect the site and provide a summary of findings to the Owner and for record.

B. The contractor shall verify that all necessary, specified and provided systems are ready to be turned over to the Owner *PRIOR* to requesting that the Engineer perform final system evaluations. The Contractor is responsible for providing completed systems without dependence upon the Engineer or other Owner representatives.

3.5 DELIVERY, HANDLING AND STORAGE:

A. The Contractor shall provide factory shipping cartons for each piece of equipment and control device. Provide factory applied plastic end caps on each length of tubing. Maintain cartons and end caps through shipping, storage and handling as required to prevent equipment and tubing damage, and to eliminate dirt and moisture from entering equipment and lodging inside of tubing. Store equipment and materials inside an enclosure provided by Contractor and protected from weather.

3.6 CONTROL WIRING:

A. Install all electric wiring in accordance with ANSI/NFPA 70, this specification and Division 26 (as applicable).

B. Install control wiring, without splices between terminal points, using an assigned color-code and numbered on both ends. Install in neat, workmanlike manner, securely fastened. Install in accordance with this specification.

1. Install circuits over 25-volt with color-coded 90°F, 600 volt insulation, minimum No. 14 AWG wire in conduit.
2. Install circuits under 25-volt with color-coded minimum No. 16 wire in conduit with high temperature (105°F (41°C) plastic insulation on each conductor and plastic sheath over all. Provide shielded cables where indicated on plans or where required by the instrument provided.
3. Provide surge protection on all control and control power circuits routed outside of the electrical rack. Surge protection shall consist of surge suppressers, transient, protectors and optical isolated relays as applicable.

3.7 CONTROL PANELS:

A. Mount new control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. Provide engraved plastic nameplates for instrument and controls inside cabinet and engraved lamicoid nameplates on cabinet face.

3.8 DATA CABLES:

A. General: Install all signal transmission components in accordance with ANSI C2, Form 511A, and Division 27 requirements as applicable.

B. Keep cable runs as short as possible, allowing extra length for connections to terminal boards. In particular, do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter. Use sleeves or grommets to protect cables from vibration at points

where they pass around sharp corners or through penetrations.

C. Grounding shall be in accordance with ANSI C2. All ground wire shall be copper.

D. Provide transient protection for all non-fiber optic data cables existing the Electrical Service Building. Transient protection devices shall be compatible with the type of data cable and the communication baud rate.

3.9 TESTING:

A. Field Test: When installation of the system is complete, calibrate equipment and verify operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the installer and witnessed by the Owner's Representative. Provide a detailed crosscheck of each sensor within the system by making a comparison between the reading at the sensor and a standard traceable to the National Bureau of Standards.

B. Provide a crosscheck of each control point within the system by making a comparison between the control command and the field-controlled device. Verify that all systems are operable from local controls. Submit the results of functional and diagnostic tests and calibrations to the Owner's Representative for final system acceptance.

C. At necessary points during construction and upon completion of the work, demonstrate system operation to Owner's designated representative, for verification of proper operation.

D. Provide factory trained, certified installer of the credit card reader/fuel management system on site for initialization and start up.

END OF SECTION

SECTION 23 11 16

SYSTEM 1 – FACILITY FUEL PIPING - UNLEADED

PART 1 – GENERAL

1.1 DESCRIPTION:

A. This section includes the design, fabrication, and delivery of (1) 2,000-gallon aboveground horizontal double wall fuel tank for regular unleaded gasoline service. Tank shall be constructed in accordance with UL-2085 and so labeled. The tank and components shall be suitable for use with regular unleaded gasoline.

B. The 2,000-gallon storage tank shall be horizontal, double-wall, welded steel tanks for aboveground storage of the specified product.

C. Tank shall be equipped with specified appurtenances and all specified equipment. The arrangement of nozzles and appurtenances is shown on the drawings.

D. The Tank Manufacturer shall not supply, furnish, or install any pipe flanges, fittings, bolts or nuts of foreign manufacture. All pipe flanges, fittings, bolts and nuts shall be manufactured in the United States of America, and the Manufacturer warrants the U.S.A. origin of all such items. The Manufacturer shall provide written certification from the manufacturer as to the origin of all flanges, fittings, bolts, and nuts installed on the project.

1.2 RELATED SECTIONS

A. Section 23 10 10 – Fuel System General Provisions

B. Section 23 10 30 – Fuel System Controls

C. Section 23 10 20 – Installation, Testing, and Flushing

1.3 REFERENCES

A. Applicable Standards:
   1. Recognized Aboveground Storage Tank System Codes Including:
      a. American National Standards Institute (ANSI):
         1) B1.20.1 - General Purpose Pipe Threads
      b. National Electrical Manufacturers Association (NEMA)
      c. Military Specifications:
         1) MIL-C-4556 - Coating Kit, Epoxy, for Interior of Steel Fuel Tanks.

d. Underwriters' Laboratories (UL):
   1) 142 – Steel Aboveground Tanks for Flammable and Combustible Liquids
   2) 2085 – "Protected"
e. American Society of Mechanical Engineers
   1) International Boiler and Pressure Vessel Code
f. NFPA 30, Flammable and Combustible Liquids Code
g. International Fire Code
h. OSHA 29 CFR 1910 – Occupational Safety and Health Standards
i. API 2000 – Venting Atmospheric and Low-Pressure Storage Tanks

1.4 SUBMITTALS

A. Submit compliance submittals in accordance with Section 01 33 00 and include the following:
   1. Complete tank layout drawing including material thickness
   2. Tank specifications
   3. Complete details of tank, saddle supports, and piping, including critical dimensions and locations of all fittings, equipment, man-ways, accessories, and tank anchor locations.
   4. Coatings with documented quality control criteria and procedures
   5. Bill of materials
   6. Product data on all equipment
   7. Manufacturer shall submit certification that equipment will comply with performance requirements as specified
   8. Manufacturer shall submit certification that the tank has successfully completed all required shop leakage tests per UL-142 and UL-2085 and other applicable codes.
   9. Mill certifications on all steel, pipe and fittings used
   10. Welding procedures and welding qualifications
   11. Signage and nameplate data
   12. Warranty information
   13. Hydraulic calculations based upon actual piping layout and equipment being provided to ensure the design flow rate.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: All equipment and material shall be the latest design, new, and the highest quality standard product of manufacturers regularly engaged in the production of such equipment and material for a minimum of 5 years. The manufacturer shall have assemblies that have been in satisfactory use in similar service for not less than 5 years.

B. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX. Submit qualification reports in the format as suggested in Appendix B of Section IX.

C. When two or more units of the same class of equipment are required, they shall be the products of a single manufacturer.

D. Coating applicator shall have a minimum of 5 years of experience in the application of the type of coating system used.

E. Performance Characteristics: Tank shall be built in strict accordance with NFPA 30, UL 142, and UL-2085, and shall be inspected and labeled by Underwriters Laboratories, Inc.

1.6 DELIVERY, STORAGE AND HANDLING

A. Provide and pay all freight, express, trucking, transportation, cartage and handling for equipment and materials. Pay for extra handling and shipping expenses incurred in expediting material, etc., to prevent interruption of the overall job progress.

B. Protect internal and external parts against rust and corrosion.

C. Pack items with factory applied covers, caps or blinds on all flanges and connections.

D. Protect internal components against damage from rattling, shifting and moving.

E. Spot paint all equipment where the shop paint has been damaged or flaked off.

F. Pay all demurrage charges resulting from the unloading operation.

1.7 WARRANTY

A. Not used

PART 2 - PRODUCTS

2.1 REUSED DOUBLE WALL HORIZONTAL TANK

A. The reused tank was manufactured by a facility licensed by the Steel Tank Institute and are experienced in the construction of UL 2085 horizontal steel tanks.

B. The tank shall be horizontal and shall be of a double wall steel construction conforming to UL 2085 and so labeled. The primary tank shall have a nominal capacity of 2,000 U.S. gallons and shall be nominally 7’-6” dia. X 12’-0” in length.

C. The tank shall be supported by two saddles each tank. Saddles shall conform to UL 142 and 2085 as applicable and shall be welded to the tank. Saddles shall provide 4- inch clearance between bottom of tank and bottom of saddle. Saddles shall be designed to meet the Uniform Building Code.

D. The tank shall have a tank-strapping table developed by an independent contractor after the tank is fabricated. Strapping chart shall take the 1% slope into account as the tank will set when installed and shall be based on readings at the nozzle connection for the electronic level gauge.

E. Shell and head joints shall be butt joints with full penetration welds. Welds located on the interior of the tank shall be ground smooth to accommodate the internal coating of the tank. Joint details shall be shown on the manufacturer drawings.

F. All piping shall include pipe, fittings, valves, supports, and shall be of Sch 40 carbon steel construction and in conformance with the materials specified in Paragraph 2.04 of this specification.

G. The tank shall be installed off level by setting the tank supports flush on the two concrete pedestals which are set at different elevations. This will provide a 1% slope of the tank draining to the low end with the water draw off connection. The tank saddles shall be designed to accommodate this slope.

2.2 APPURTENANCES

A. All appurtenances shall be at the locations indicated on the drawings. The following table provides a schedule of the tank appurtenances.

A. 2” FNPT	Interstitial Monitor
B. 4” MNPT	3” Fill with Overfill Valve and drop tube
D. 2” MNPT	Manual Gauge Port
E. 6” MNPT	Emergency Vent
E. 6” MNPT	Emergency Vent
G. 4” MNPT	Monitor Probe Opening
H. 3” Primary Pressure/Vacuum Vent	8 oz. pressure setting
I. 2” MNPT	Clock Gauge for level reading
G. 3” ANSI 150 R.F.	From Vapor Recovery Tee on Primary Vent
H. 2” MNPT	1” Anti-Siphon Valve with Drop Tube. Drop tube to be 1” in diameter and within 1/8 inch of tank bottom.

B. Tank fill drop tubes shall reach from top of tank to within 6” of bottom of tank as indicated on the drawings.

2.3 LADDERS AND PLATFORMS

A. Not used

2.4 EQUIPMENT

A. All equipment shall be provided with the tanks and shall be new and have a one year warranty by the tank manufacturer or the supplier. If defects arise, the manufacturer shall replace or repair the equipment at the Owner's discretion at no cost to the Owner

B. Pressure Vacuum Vent (regular unleaded gasoline tank)
1. Normal vent cap shall be a pressure/vacuum vent and shall mate to 3" NPT connection. Materials of construction shall be anodized aluminum with a brassscreen and Buna-N body seal. Vent shall be sized for a minimum 1881 SCFH inbreathing and 1881 SCFH outbreathing with a maximum fill rate of 200 gpm and a maximum withdrawal rate of 200 gpm. Pressure vacuum setting shall be 8 oz/sqin.

C. Emergency Vent (regular unleaded gasoline Primary and Secondary Tanks)
1. Emergency vent shall be an automatically resetting 6" NPT connection, cast iron painted cover, viton o-ring seat, iron body, with 16 oz. pressure setting or approved equal. Vent shall be sized for a minimum 420,000 SCFH.

D. Manual Gauge Hatch
1. The stick gauging hatch shall be a cam and groove side seal adapter with locking cap.

E. Manual Stick Gauge

1. Provide a wooden stick gauges 12' in length with units of measure in inches and minimum resolution of 1/8" for the tanks. Provide a 1 ½" dia. PVC pipe, 12' in length mounted to the platform railing at the tank to house the gauge stick.

2.5 SUCTION PUMPS

A. Fuel is conveyed to the dispensers by suction pump located within the dispenser. The dispenser is a Gasboy 9153KTW1M with Vane pump 1- HP motor.

2.6 FINISHES

A. Not used

2.7 NAMEPLATE

A. Certification Label: Each tank shall bear a permanently affixed certification label. Nameplate shall be stainless steel stamped with the following:
1. Underwriters Laboratory label

2. Name of manufacturer
3. A unique identification number
4. Dimensions, design and working capacity and model number of the tank
5. Year of manufacture

B. Tank supplier shall **not** provide additional labeling of the tank advertising the manufacturer and the UL 2085 rating. Only the items required by code and that are required in these specifications shall be included.

PART 3 - EXECUTION

3.1 FABRICATION FACILITY INSPECTIONS

A. Manufacturer shall establish an inspection visit schedule with dates at key points in the fabrication of the tank systems. Provide schedule of dates to the Owner and Engineer four weeks prior to first inspections.

3.2 TESTING

A. Perform all shop performance tests required by UL 2085, including, but not limited to, tank leakage and hydrostatic strength tests. Test both the primary and secondary containment tanks. Provide all test results.

3.3 DELIVERY

A. The delivery of the tanks shall be coordinated with the Contractor to ensure the site is ready for delivery.

B. The tanks shall be clean and wiped down prior to shipment. All nozzles shall either have the specified equipment installed or temporary covers to prevent contamination during storage and delivery.

3.4 INSTALLATION:

A. The tank manufacturer shall provide the tank vents as specified and shall install all equipment either at the factory or on site at the time of delivery.

B. The tanks are designed to rest on concrete pedestals, two per tank, as shown.

C. It shall be the Contractor's responsibility or his designee to offload and set the tanks and install the platforms. Provide any manufacturer instructions required to perform proper installation.

D. The Contractor shall field repair any damage to coatings as a result of delivery and installation. Coating system shall be identical to the system used by the tank manufacturer.

END OF SECTION

SECTION 23 11 19

SYSTEM 2 – FACILITY FUEL PIPING - DIESEL

PART 1 – GENERAL

1.1 DESCRIPTION:

A. This section includes the design, fabrication, and delivery of (1) 2,000-gallon aboveground horizontal double wall fuel tank for diesel fuel service. Tank shall be constructed in accordance with UL-2085 and so labeled. The tank and components shall be suitable for use with diesel fuel.

B. The 2,000-gallon storage tank shall be horizontal, double-wall, welded steel tanks for aboveground storage of the specified product.

C. Tank shall be equipped with specified appurtenances and all specified equipment. The arrangement of nozzles and appurtenances is shown on the drawings.

D. The Tank Manufacturer shall not supply, furnish, or install any pipe flanges, fittings, bolts or nuts of foreign manufacture. All pipe flanges, fittings, bolts and nuts shall be manufactured in the United States of America, and the Manufacturer warrants the U.S.A. origin of all such items. The Manufacturer shall provide written certification from the manufacturer as to the origin of all flanges, fittings, bolts, and nuts installed on the project.

1.2 RELATED SECTIONS

A. Section 23 10 10 – Fuel System General Provisions

B. Section 23 10 30 – Fuel System Controls

C. Section 23 10 20 – Installation, Testing, and Flushing

1.3 REFERENCES

A. Applicable Standards:
   1. Recognized Aboveground Storage Tank System Codes Including:
      a. American National Standards Institute (ANSI):
         1) B1.20.1 - General Purpose Pipe Threads
      b. National Electrical Manufacturers Association (NEMA)
      c. Military Specifications:
         1) MIL-C-4556 - Coating Kit, Epoxy, for Interior of Steel Fuel Tanks.

d. Underwriters' Laboratories (UL):
   1) 142 – Steel Aboveground Tanks for Flammable and Combustible Liquids
   2) 2085 – "Protected"
e. American Society of Mechanical Engineers
   1) International Boiler and Pressure Vessel Code
f. NFPA 30, Flammable and Combustible Liquids Code
g. International Fire Code
h. OSHA 29 CFR 1910 – Occupational Safety and Health Standards
i. API 2000 – Venting Atmospheric and Low-Pressure Storage Tanks

1.4 SUBMITTALS

A. Submit compliance submittals in accordance with Section 01 33 00 and include the following:
   1. Complete tank layout drawing including material thickness
   2. Tank specifications
   3. Complete details of tank, saddle supports, and piping, including critical dimensions and locations of all fittings, equipment, man-ways, accessories, and tank anchor locations.
   4. Coatings with documented quality control criteria and procedures
   5. Bill of materials
   6. Product data on all equipment
   7. Manufacturer shall submit certification that equipment will comply with performance requirements as specified
   8. Manufacturer shall submit certification that the tank has successfully completed all required shop leakage tests per UL-142 and UL-2085 and other applicable codes.
   9. Mill certifications on all steel, pipe and fittings used
   10. Welding procedures and welding qualifications
   11. Signage and nameplate data
   12. Warranty information
   13. Hydraulic calculations based upon actual piping layout and equipment being provided to ensure the design flow rate.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: All equipment and material shall be the latest design, new, and the highest quality standard product of manufacturers regularly engaged in the production of such equipment and material for a minimum of 5 years. The manufacturer shall have assemblies that have been in satisfactory use in similar service for not less than 5 years.

B. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX. Submit qualification reports in the format as suggested in Appendix B of Section IX.

C. When two or more units of the same class of equipment are required, they shall be the products of a single manufacturer.

D. Coating applicator shall have a minimum of 5 years of experience in the application of the type of coating system used.

E. Performance Characteristics: Tank shall be built in strict accordance with NFPA 30, UL 142, and UL-2085, and shall be inspected and labeled by Underwriters Laboratories, Inc.

1.6 DELIVERY, STORAGE AND HANDLING

A. Provide and pay all freight, express, trucking, transportation, cartage and handling for equipment and materials. Pay for extra handling and shipping expenses incurred in expediting material, etc., to prevent interruption of the overall job progress.

B. Protect internal and external parts against rust and corrosion.

C. Pack items with factory applied covers, caps or blinds on all flanges and connections.

D. Protect internal components against damage from rattling, shifting and moving.

E. Spot paint all equipment where the shop paint has been damaged or flaked off.

F. Pay all demurrage charges resulting from the unloading operation.

1.7 WARRANTY

A. Not used

PART 2 - PRODUCTS

2.1 REUSED DOUBLE WALL HORIZONTAL TANK

A. The reused tank was manufactured by a facility licensed by the Steel Tank Institute and are experienced in the construction of UL 2085 horizontal steel tanks.

B. The tank shall be horizontal and shall be of a double wall steel construction conforming to UL 2085 and so labeled. The primary tank shall have a nominal capacity of 2,000 U.S. gallons and shall be nominally 7’-6” dia. X 12’-0” in length.

C. The tank shall be supported by two saddles each tank. Saddles shall conform to UL 142 and 2085 as applicable and shall be welded to the tank. Saddles shall provide 4- inch clearance between bottom of tank and bottom of saddle. Saddles shall be designed to meet the Uniform Building Code.

D. The tank shall have a tank-strapping table developed by an independent contractor after the tank is fabricated. Strapping chart shall take the 1% slope into account as the tank will set when installed and shall be based on readings at the nozzle connection for the electronic level gauge.

E. Shell and head joints shall be butt joints with full penetration welds. Welds located on the interior of the tank shall be ground smooth to accommodate the internal coating of the tank. Joint details shall be shown on the manufacturer drawings.

F. All piping shall include pipe, fittings, valves, supports, and shall be of Sch 40 carbon steel construction and in conformance with the materials specified in Paragraph 2.04 of this specification.

G. The tank shall be installed off level by setting the tank supports flush on the two concrete pedestals which are set at different elevations. This will provide a 1% slope of the tank draining to the low end with the water draw off connection. The tank saddles shall be designed to accommodate this slope.

2.2 APPURTENANCES

A. All appurtenances shall be at the locations indicated on the drawings. The following table provides a schedule of the tank appurtenances.

A. 2” FNPT	Interstitial Monitor
B. 4” MNPT	3” Fill with Overfill Valve and drop tube
D. 2” MNPT	Manual Gauge Port
E. 6” MNPT	Emergency Vent
E. 6” MNPT	Emergency Vent
G. 4” MNPT	Monitor Probe Opening
H. 3” Primary Pressure/Vacuum Vent	8 oz. pressure setting
I. 2” MNPT	Clock Gauge for level reading
G. 3” ANSI 150 R.F.	From Vapor Recovery Tee on Primary Vent
H. 2” MNPT	1” Anti-Siphon Valve with Drop Tube. Drop tube to be 1” in diameter and within 1/8 inch of tank bottom.

B. Tank fill drop tubes shall reach from top of tank to within 6” of bottom of tank as indicated on the drawings.

2.3 LADDERS AND PLATFORMS

A. Not used

2.4 EQUIPMENT

A. All equipment shall be provided with the tanks and shall be new and have a one year warranty by the tank manufacturer or the supplier. If defects arise, the manufacturer shall replace or repair the equipment at the Owner's discretion at no cost to the Owner

B. Pressure Vacuum Vent (diesel fuel tank)
1. Normal vent cap shall be a pressure/vacuum vent and shall mate to 3" NPT connection. Materials of construction shall be anodized aluminum with a brassscreen and Buna-N body seal. Vent shall be sized for a minimum 1881 SCFH inbreathing and 1881 SCFH outbreathing with a maximum fill rate of 200 gpm and a maximum withdrawal rate of 200 gpm. Pressure vacuum setting shall be 8 oz/sqin.

C. Emergency Vent (diesel fuel Primary and Secondary Tanks)
1. Emergency vent shall be an automatically resetting 6" NPT connection, cast iron painted cover, viton o-ring seat, iron body, with 16 oz. pressure setting or approved equal. Vent shall be sized for a minimum 420,000 SCFH.

D. Manual Gauge Hatch
1. The stick gauging hatch shall be a cam and groove side seal adapter with locking cap.

E. Manual Stick Gauge

1. Provide a wooden stick gauges 12' in length with units of measure in inches and minimum resolution of 1/8" for the tanks. Provide a 1 ½" dia. PVC pipe, 12' in length mounted to the platform railing at the tank to house the gauge stick.

2.5 SUCTION PUMPS

A. Fuel is conveyed to the dispensers by suction pump located within the dispenser. The dispenser is a Gasboy 9153KTW1M with Vane pump 1- HP motor.

2.6 FINISHES

A. Not used

2.7 NAMEPLATE

A. Certification Label: Each tank shall bear a permanently affixed certification label. Nameplate shall be stainless steel stamped with the following:
1. Underwriters Laboratory label

2. Name of manufacturer
3. A unique identification number
4. Dimensions, design and working capacity and model number of the tank
5. Year of manufacture

B. Tank supplier shall **not** provide additional labeling of the tank advertising the manufacturer and the UL 2085 rating. Only the items required by code and that are required in these specifications shall be included.

PART 3 - EXECUTION

3.1 FABRICATION FACILITY INSPECTIONS

A. Manufacturer shall establish an inspection visit schedule with dates at key points in the fabrication of the tank systems. Provide schedule of dates to the Owner and Engineer four weeks prior to first inspections.

3.2 TESTING

A. Perform all shop performance tests required by UL 2085, including, but not limited to, tank leakage and hydrostatic strength tests. Test both the primary and secondary containment tanks. Provide all test results.

3.3 DELIVERY

A. The delivery of the tanks shall be coordinated with the Contractor to ensure the site is ready for delivery.

B. The tanks shall be clean and wiped down prior to shipment. All nozzles shall either have the specified equipment installed or temporary covers to prevent contamination during storage and delivery.

3.4 INSTALLATION:

A. The tank manufacturer shall provide the tank vents as specified and shall install all equipment either at the factory or on site at the time of delivery.

B. The tanks are designed to rest on concrete pedestals, two per tank, as shown.

C. It shall be the Contractor's responsibility or his designee to offload and set the tanks and install the platforms. Provide any manufacturer instructions required to perform proper installation.

D. The Contractor shall field repair any damage to coatings as a result of delivery and installation. Coating system shall be identical to the system used by the tank manufacturer.

END OF SECTION

SECTION 23 21 13

CONDENSATE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:
   1. Steel pipe and fittings.
   2. Joining materials.
   3. Transition fittings.
   4. Dielectric fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Pipe.
   2. Fittings.
   3. Joining materials.

B. Delegated-Design Submittal:
   1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
   2. Locations of pipe anchors and alignment guides and expansion joints and loops.
   3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
   4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Condensate-Drain Piping: 150 deg F.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type K.

B. Wrought-Copper Unions: ASME B16.22.

2.3 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 joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:
1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:
1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.5 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.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Above Ground Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Below Ground Condensate Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

3.2 PIPING INSTALLATIONS

A. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

B. 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.

C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

D. Install piping at indicated slopes.

E. Install piping free of sags and bends.

F. Install fittings for changes in direction and branch connections.

G. Install piping to allow application of insulation.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

J. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

K. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

L. Install shutoff valve immediately upstream of each dielectric fitting.

M. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.

N. 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."

O. 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."

P. 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."

3.3 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 unions.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 23 0529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 23 0548.13 "Vibration Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Spring hangers to support vertical runs.
4. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
5. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 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. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. 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.

F. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 FIELD QUALITY CONTROL

A. Prepare condensate piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.

END OF SECTION

SECTION 23 21 23

HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Automatic condensate pump units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of pump.

B. Shop Drawings: For each pump.
   1. Show pump layout and connections.
   2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
   3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 AUTOMATIC CONDENSATE PUMP UNITS

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. Little Giant Pump Co.

B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch- minimum, electrical power cord with plug.

C. Capacities and Characteristics: As described on drawings.

2.2 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:
   1. Angle pattern.
   2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
   3. Bronze startup and bronze or stainless-steel permanent strainers.
   4. Bronze or stainless-steel straightening vanes.
   5. Drain plug.
   6. Factory-fabricated support.

B. Triple-Duty Valve:
   1. Angle or straight pattern.
   2. 175-psig pressure rating, cast-iron body, pump-discharge fitting.
   3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
   4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

D. Equipment Mounting:
   1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

3.2 ALIGNMENT

A. Comply with pump and coupling manufacturers' written instructions.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install Y-type strainer and shutoff valve on suction side of pumps.

F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

G. Install check valve and gate or ball valve on each condensate pump unit discharge.

H. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

A. Section Includes:
1. Refrigerant pipes and fittings.
2. Refrigerant piping valves and specialties.
3. Refrigerants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and refrigerant piping specialty.

B. Shop Drawings:
1. 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.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

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 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8/A5.8M.

F. 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. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. 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. 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 115-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

F. 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.

G. 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.

6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 450 psig.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal.
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 115-V ac coil.
8. End Connections: Socket.
9. Throttling Range: Maximum 5 psig.
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

J. 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.

K. 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.

L. 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 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.

M. 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 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.

2.4 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-134a

A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type K, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-407C

A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type K Type L, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.3 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with soldered joints.

E. Safety-Relief-Valve Discharge Piping: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with soldered joints.

3.4 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-size, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. 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.

H. 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.

I. 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.

J. 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.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

3.5 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 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 if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective conduit where installed below ground.

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."

3.6 PIPE 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. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

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.

3.7 HANGERS AND SUPPORTS

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 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.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
   1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
   2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
   3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
   4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
   5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
   6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
   7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
   8. NPS 3: Maximum span, 10 feet; minimum rod, 3/8 inch.
   9. NPS 4: Maximum span, 12 feet; minimum rod, 1/2 inch.

D. Support multi-floor vertical runs at least at each floor.

3.8 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.

3.9 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.

3.10 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. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. 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.

C. Note: All references to SMACNA documents herein implies latest version of SMACNA document.

D. Note: 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."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
1. Liners and adhesives.
2. Sealants and gaskets.

B. Sustainable Design Submittals:
1. Product Data: For adhesives, indicating VOC content.
2. Sealants shall have a VOC content of 420 g/L or less.
3. Water Based Joint and Seam Sealant: VOC: Maximum 75 g/L (less water).
4. Sustainable design requiring compliance with ASHRAE 62.1 must comply with requirements of Section 7.2.4 - "Ventilation System Start-up," which requires that distribution systems be clean of dirt and debris.

C. 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. Fittings.
6. Penetrations through fire-rated and other partitions.
7. Equipment installation based on equipment being used on Project.
8. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
9. Hangers and supports, including methods for duct and building attachment and vibration isolation.

D. 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.

1.4 INFORMATIONAL SUBMITTALS (FOR RECORD ONLY)

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, as applicable.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. 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. Minimum 24 gauge ductwork.
   2. Construct ducts of galvanized sheet steel unless otherwise indicated.
   3. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. 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.

C. 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."

D. 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 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.
   2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

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."

2.4 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: G60 or G90.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.

D. 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.

E. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Factory- or Shop-Applied Antimicrobial Coating:
   1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
   2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
   4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
   5. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

G. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

A. Duct liner shall only provided where explicitly indicated on drawings for sound mitigation..

B. Sustainable design schemes require that duct insulation R-value comply with ASHRAE/IES 90.1 tables titled "Minimum Duct Insulation R-Value." If using liner alone to satisfy thermal requirements, verify that material selected is available in thickness needed to provide thermal performance without jeopardizing other requirements

C. Flexible Elastomeric Duct Liner for temperatures 220 deg F and lower: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
   2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

D. Insulation Pins and Washers:
   1. 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.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter. Galvanized steel for normal applications; stainless steel or aluminum where exposed to exterior weather; stainless steel where exposed to corrosive environments.

E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2000 fpm or greater.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2000 fpm or where indicated.
9. For double walled ductwork, secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 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. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 4 inches.
   3. Sealant: Modified styrene acrylic.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

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. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

7. Service: Indoor or outdoor.
8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
9. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
10. Service: Indoor or outdoor.
11. 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.

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.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. 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."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.

E. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. 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.

3.2 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.

3.3 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to have secure watertight mechanical connections; if welding is required per other sections of the specifications, welding requirement shall prevail. 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.
   2. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 23 07 13 "Duct Insulation."

3.4 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."

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. 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.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. 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.

3.6 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.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests for ducts in pressure classes 3-inch wg and higher:
   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 greater than or equal to 4-Inch wg but lower than 6-Inch wg: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
   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 ten business 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.

3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use duct cleaning methodology as indicated in NADCA ACR.

C. Use service openings for entry and inspection.
   1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

D. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

E. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

F. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.9 STARTUP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.10 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 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: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   2. Ducts Connected to Constant-Volume Air-Handling 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: 6.
   3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
      a. Pressure Class: Positive 4-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 6.
      d. SMACNA Leakage Class for Round: 6.
   4. 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: 6.

C. Return Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive or negative 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round: 12.
   2. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 6.
      d. SMACNA Leakage Class for Round: 6.
   3. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive or negative 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 6.
      d. SMACNA Leakage Class for Round: 3.

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 2-inch wg.

b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round: 6.

2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round: 6.
3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
   a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
   b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
   c. Welded seams and joints.
   d. Pressure Class: Positive or negative 3-inch wg.
   e. Airtight/Watertight.

E. 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.
      2) Mitered Type RE 4 without vanes.
   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. 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 or welded.

F. Branch Configuration: Contractor shall follow the below if not clarified in details on the drawings:

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: 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: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical 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 SUMMARY

A. Section Includes:
1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Duct access panel assemblies.
10. Flexible connectors.
11. Duct accessory hardware.

B. Related Requirements:
1. Section 23 33 46 "Flexible Ducts" for insulated and non-insulated flexible ducts.

C. Note: All references to SMACNA documents herein implies latest version of SMACNA document.

1.2 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.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work. Indicate reflected ceiling plans drawn to scale and coordinated with each trade, using input from installers of the items involved
1. 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, including wiring diagrams for power, signal and control wiring.
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. Include wiring diagrams for power, signal and control wiring for smoke dampers and combination fire and smoke dampers.

1.3 CLOSEOUT SUBMITTALS

A. As-Builts.

B. Operation and maintenance data.

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. Description: Gravity balanced.

B. Performance:
1. Maximum Air Velocity: 2500 fpm.
2. Maximum System Pressure: 4 inches wg.
3. AMCA Certification: Test and rate in accordance with AMCA 511.
4. Leakage:
   a. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

C. Construction:
1. Frame:
   a. Hat shaped.
   b. For dampers installed in galvanized sheet metal ductwork, damper frame shall be 16-gauge, galvanized sheet steel; for dampers installed in aluminum ductwork, damper frame shall be 0.093-inch-thick extruded aluminum; for dampers installed in stainless steel ductwork, damper frame shall be 18-gauge stainless steel. Frame shall be welded or mechanically attached corners and shall include mounting flange.
2. Blades:
   a. Multiple single-piece blades.
   b. Center pivoted, maximum 6-inch width with sealed edges. For dampers installed in galvanized sheet metal ductwork, damper blades shall be 16-gauge, galvanized sheet steel; for dampers installed in aluminum ductwork, damper blades shall be] 0.050-inch-thick aluminum sheet; for dampers installed in stainless steel ductwork, damper blades shall be 26-gauge Type 304 stainless steel.
3. Blade Action: Parallel.

D. Blade Seals: Neoprene, mechanically locked.

E. Materials for blade axles, tie bars and brackets shall match ductwork material.

F. Return Spring: Adjustable tension.

G. Bearings: Steel ball with brass sleeve.

H. Damper Actuator - Electric:
1. Electric voltage to be coordinated with Electrical Contractor.
2. UL 873 plenum rated.
3. Two position with fail-safe spring return.
   a. Sufficient motor torque and spring torque to drive damper 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. Humidity: 5 to 95 percent relative humidity noncondensing.
6. Environmental Enclosure: NEMA rated enclosure suitable for environment of installation.
7. Actuator to be factory mounted and provided with a single-point wiring connection.

I. Controllers, Electrical Devices, and Wiring:

J. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Chain pulls.
4. Screen Mounting:
   a. Front or rear mounted in sleeve, with sleeve thickness 20 gauge minimum and sleeve length 6 inches minimum.
5. Screen shall be galvanized steel with bird screen and 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. In addition to those indicated on the drawings, note that individual volume dampers shall be implemented for all air outlet devices.

B. Standard, Steel, Manual Volume Dampers:
1. Performance:
   a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
2. Construction:
   a. Linkage out of airstream.
   b. Suitable for horizontal or vertical airflow applications.
3. Frames:
   a. Hat-shaped. For dampers installed in galvanized ductwork, damper frames shall be 16-gauge-thick, galvanized sheet steel. For dampers installed in stainless steel ductwork, damper frames shall be 18-gauge-thick stainless steel.
   b. Mitered and welded corners.

c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:
   a. Opposed-blade design.
   b. Stiffen damper blades for stability.
   c. 16 gauge thick. For dampers installed in galvanized ductwork, damper blades shall be galvanized steel. For dampers installed in stainless steel ductwork, damper blades shall be stainless steel.
5. Blade Axles: Galvanized steel when installed in galvanized ductwork, and stainless steel when installed in stainless steel ductwork.
6. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
7. Tie Bars and Brackets: Galvanized steel.
8. Locking device to hold damper blades in a fixed position without vibration.

C. Standard, Aluminum, Manual Volume Dampers for installation in aluminum ducts.
1. Performance:
   a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
2. Construction:
   a. Linkage out of airstream.
   b. Suitable for horizontal or vertical airflow applications.
3. Frames:
   a. Hat-shaped, 0.10-inch-thick, aluminum sheet channels.
   b. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
   a. Multiple blade or single blade
   b. Opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
5. Blade Axles: Galvanized steel.
6. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
7. Tie Bars and Brackets: Aluminum.
8. Locking device to hold damper blades in a fixed position without vibration.

D. Jackshaft:
1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 CONTROL DAMPERS

A. 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.

B. Performance:
1. AMCA Certification: Test and rate in accordance with AMCA 511.
2. Leakage:
   a. Class II: Leakage shall not exceed 10 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: Rated up to 2,500 fpm. If resulting air velocity through a duct is larger than 2,500 fpm, damper rating shall be at least that value.
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.

C. Construction:
1. Linkage out of airstream.
2. Suitable for horizontal or vertical airflow applications.
3. Frames:
   a. Hat, U, or angle shaped.
   b. 0.08-inch-thick extruded aluminum if installed in aluminum ductwork; 16-gauge-thick, galvanized sheet steel if installed in galvanized sheet metal ductwork; 18-gauge-thick stainless steel if installed in stainless steel ductwork.
   c. Corners shall be either of the following: Mitered and welded; or interlocking and gusseted.
   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. Material to match duct: Either galvanized steel, stainless steel, or aluminum.
   d. 16-gauge-thick single skin.
5. Blade Edging Seals:
   a. Replaceable closed-cell neoprene.
   b. Inflatable seal blade edging, or replaceable rubber seals.
6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch diameter; material to match duct (galvanized or stainless steel).

8. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
9. Bearings:
    a. Oil-impregnated bronze.
    b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

D. Damper Actuator - Electric:
1. Electric voltage to be coordinated with Electrical Contractor.
2. UL 873, plenum rated.
3. Fully modulating 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 rated enclosure suitable for environment of installation.
7. Actuator to be factory mounted and provided with a single-point wiring connection.

2.5 FIRE DAMPERS

A. Type: Dynamic (spring actuated, not gravity actuated); rated and labeled in accordance with UL 555 by an NRTL.

B. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2,500 fpm velocity.

C. Fire Rating: 1-1/2 hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing. Frame shall be 304 Stainless Steel where installed in corrosive environments.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing. Mounting sleeve shall be 304 Stainless Steel where installed in corrosive environments.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed galvanized sheet steel, interlocking full-length steel blade connectors. Material gauge is to be in accordance with UL listing. Blades shall be 304 Stainless Steel where installed in corrosive environments.

H. Heat-Responsive Device:
1. Replaceable, 212 deg F rated, fusible links.

2.6 SMOKE DAMPERS

A. 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.

B. Performance:
1. AMCA Certification: Test and rate in accordance with AMCA Publication 511.
2. Leakage:
   a. Class II: Leakage shall not exceed 10 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.

C. Construction:
1. Suitable for horizontal or vertical airflow applications.
2. Linkage out of airstream.
3. Frame:
   a. Hat shaped.
   b. Galvanized sheet steel if installed in galvanized ductwork; Stainless steel is installed in stainless steel ductwork. Use welded, interlocking, gusseted or mechanically attached corners and mounting flange.
   c. Gauge in accordance with UL listing.
4. Blades:
   a. Roll-formed, horizontal, airfoil. Use galvanized sheet steel if installed in galvanized ductwork. Use stainless steel if installed in stainless steel ductwork. Use extruded aluminum if installed in aluminum ductwork.
   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 if installed in galvanized ductwork; stainless steel if installed in stainless steel ductwork; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage is to be mounted out of airstream.
8. Bearings: Oil-impregnated bronze.

D. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking; gauge in accordance with UL listing.

E. Damper Actuator - Electric:
1. Electric voltage to be coordinated with Electrical Contractor.
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 10-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 rated enclosure suitable for environment of installation.
8. Actuator to be factory mounted and provided with single-point wiring connection.

F. Accessories:
1. Auxiliary switches for signaling, fan control, and position indication.
2. Test and reset switches,remote mounted.
3. Smoke Detector: Integral, factory wired for single-point connection.

2.7 FLANGE CONNECTORS

A. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gauge and Shape: Match connecting ductwork.

2.8 TURNING VANES

A. 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.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

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: Single wall for ducts up to 12 inches wide and double wall for larger dimensions.

2.9 DUCT-MOUNTED ACCESS DOORS

A. 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. For installation in galvanized ductwork, use 24-gauge-thick galvanized steel; For installation in aluminum ductwork, use 0.032-inch-thick aluminum; For installation in stainless steel ductwork, use 24-gauge-thick stainless steel door panel.
      d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
      e. Fabricate doors airtight and suitable for duct pressure class.
   2. Frame: Material to match ductwork material (for aluminum ductwork, utilize galvanized sheet steel), with bend-over tabs and foam gaskets.
      a. For galvanized steel or stainless steel, use minimum 24-gauge-thick galvanized steel; for aluminum ductwork, use minimum 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: Two sash locks, with either two hinges or continuous hinges.
      c. Access Doors up to 24 by 48 Inches and Larger: Continuous hinge and two compression latches with outside and inside handles.

B. Pressure Relief Access Door:
   1. Door and Frame Material: Galvanized sheet steel.
      a. For installation in galvanized ductwork, use 24-gauge-thick galvanized steel; for installation in aluminum ductwork, use 0.032-inch-thick aluminum; for installation in stainless steel ductwork, use 24-gauge-thick stainless steel door panel.
   2. Door: Double wall with insulation fill; metal thickness applicable for duct pressure class.
   3. Operation: Open outward for positive-pressure ducts; inward for negative-pressure ducts.
   4. Factory set at pressure to match application of system.
   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: Thickness to match insulation requirements of ductwork.

2.10 DUCT ACCESS PANEL ASSEMBLIES FOR ACCESS PANELS IN FIRE-RATED DUCT SYSTEMS, SUCH AS EXHAUST DUCTS FOR COMMERCIAL KITCHEN HOODS

A. Access panels used in cooking applications:
   1. Labeled compliant to NFPA 96 for grease duct access doors.
   2. Labeled in accordance with UL 1978 by an NRTL.

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.

2.11 FLEXIBLE CONNECTORS

A. 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.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Materials: Flame-retardant or noncombustible fabrics.

D. Coatings and Adhesives: Comply with UL 181, Class 1.

E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

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. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
   1. Minimum Weight: 16 oz./sq. yd.
   2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
   3. Service Temperature: Minus 67 to plus 500 deg F.

I. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
   1. Minimum Weight: 14 oz./sq. yd.
   2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
   3. Service Temperature: Minus 67 to plus 500 deg F.

J. 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.

2.12 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.

2.13 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
   1. Galvanized Coating Designation: G60 or G90.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and a finish designation as specified by Architect for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches. Coordinate hanger size with Licensed Structural Engineer for all hangers.

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 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. Per SMACNA recommendations, to minimize duct noise generated by volume dampers, locate dampers at least two duct diameters from fittings and as far away as possible from outlets.
   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 dampers, smoke dampers, and combination 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. For grease ducts, install at locations and spacing as required by NFPA 96.
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 8 inches.
2. Two-Hand Access: 12 by 12 inches.
3. Head and Hand Access: 18 by 18 inches.
4. Head and Shoulders Access: 24 by 24 inches.
5. Body Access: 24 by 24 inches.
6. Body plus Ladder Access: 24 by 24 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 10 HP and greater.

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 SUMMARY

A. Section Includes:
   1. Non-insulated flexible ducts.
   2. Insulated flexible ducts.

B. Note: All references to SMACNA documents herein implies latest version of SMACNA document.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

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. Insulated, Flexible Duct: UL 181, Class 1, aluminum corrugated flexible duct with fibrous-glass insulation; aluminized vapor-barrier film.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   2. Maximum Air Velocity: 3000 fpm.
   3. Temperature Range: Minus 10 to plus 160 deg F.
   4. Insulation R-Value: R6.

B. Basis of design product equal to Flexmaster TL-M

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.

B. Non-Clamp Connectors: Liquid adhesive plus tape or adhesive plus sheet metal screws.

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 diffusers or light troffer boots to ducts with maximum 24-inch lengths of flexible duct clamped or strapped in place.

D. Connect flexible ducts to metal ducts with liquid adhesive plus tape; liquid adhesive plus draw bands; liquid adhesive plus sheet metal screws.

E. Install duct test holes where required for testing and balancing purposes.

F. 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.

G. Supporting Flexible Ducts:
   1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Supports shall be connected directly to structure above. 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 maximum 72 inches o.c.

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. In-line centrifugal fans

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale and coordinated with all building trades.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Service Conditions: Per temperature and humidity ranges associated with the climate and environment of the installation, or as specifically indicated on the drawings.

B. Capacities and Electrical Characteristics: As scheduled on the Mechanical drawings.

2.2 IN-LINE CENTRIFUGAL FANS

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. Greenheck Fan Corporation.
   2. Loren Cook Company.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

E. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
   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.

F. Capacities and Characteristics: As indicated on drawings
   1. Vibration Isolators:
      a. Type: Elastomeric hangers.
      b. Static Deflection: 1 inch.

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.

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

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. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.

C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.

D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.

E. Operating Limits: Classify according to AMCA 99.

PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

A. Install power ventilators level and plumb.

B. Equipment Mounting:
   1. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

C. Install units with clearances for service and maintenance.

D. 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, as specified in Section 26 05 53 "Identification for Electrical Systems." If Section 26 05 53 does not exist, 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 26 05 19 "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
1. Verify that shipping, blocking, and bracing are removed.
2. 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.
3. Verify that there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. 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.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.7 DEMONSTRATION

A. 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 SUMMARY

A. Section includes high-volume, low-speed fans.

1.2 DEFINITIONS

A. HVLS - High volume, low speed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Provide LEED material submittals as required for certification.

C. 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.

D. 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.

1.4 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. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of fans that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Motor, Including Controls: Five year(s) from date of Substantial Completion.
      b. For Parts, Including Blades and Hub: Five 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.

2.2 CAPACITIES AND CHARACTERISTICS: Refer to Schedule

A. Fan:
   1. Type: HVLS Selectable upflow or downflow

2.3 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. Big Ass Fans.
   2. 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: Aluminum.
        1) Finish: Manufacturer standard finish.
4. Diameter: per schedule
5. Blades: Airfoil type.
    a. Quantity: 8.
    b. Material: Aluminum.
        1) Blade Finish: Anodized.
6. Motor: , integral to fan frame.
7. Wiring and Controls Enclosure:
    a. NEMA 250, Class 4X.
    b. Material: Aluminum.
        1) Enclosure Finish: Paint.
    c. Grounded.
8. Controls: Provide wall-mounted keypad.
    a. Provide variable speed motor controller speed control.
9. Standard Mounting Bracket: Steel beam/steel angle.
10. Mounting Bracket: Large beam.
11. Accessories:
    a. Mounting extension tube.

PART 3 - EXECUTION

3.1 INSTALLATION OF HIGH-VOLUME LOW-SPEED FANS

A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting HVLS fan performance, maintenance, and operations.

B. Fan locations indicated on Drawings are approximate. Determine exact locations before roughing-in for mounting, control, and electrical connections.

C. Install fan according to manufacturer's published instructions.

D. Comply with NECA 1 and NFPA 70.

E. 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.

F. Comply with NFPA 72 and interlock HVLS fans to shut down upon receiving an alarm from fire alarm system.

G. 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 230529 "Hangers and Supports for HVAC Piping and Equipment."
4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

H. Install unit to permit access for maintenance.

I. Install parts and accessories shipped loose.

J. 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 and gearbox lubrication.
5. Verify proper fan rotation.

3.2 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, as specified in Section 260553 "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.

E. Install power wiring to field-mounted electrical devices, furnished by fan manufacturer, but not factory mounted.

3.3 CONTROL CONNECTIONS

A. Connect control wiring to field-mounted control devices.

B. Connect control interlock wiring between HVLS fan and other equipment to provide a complete and functioning system.

C. Connect control wiring between fan unit control interface and control system to provide remote control and monitoring.

D. Install control devices furnished by manufacturer, but not factory mounted.

E. Install control wiring to field-mounted control devices, furnished by fan manufacturer, but not factory mounted.

F. Protect installed units from damage caused by other work.

3.4 FIELD QUALITY CONTROL

A. Testing Agency Owner Engaged: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency Contractor Engaged: Engage a qualified testing agency to perform tests and inspections.

C. 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.

D. Fan or components will be considered defective if fan or components do not pass tests and inspections.

E. Prepare and submit test and inspection reports.

3.5 ADJUSTING

A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.6 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.

3.7 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 SUMMARY

A. Section Includes:
   1. Rectangular and square ceiling diffusers.
   2. Louver face diffusers.

B. Related Requirements:
   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

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. Krueger.
   2. METALAIRE, Inc.
   3. Price Industries.
   4. Titus.
   5. Tuttle & Bailey.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Aluminum as indicated on the drawings.

D. Finish: Baked enamel, white.

E. Face Size: As indicated on the drawings.

F. Face Style: Three cone.

G. Mounting: Surface or T-bar.

H. Pattern: Adjustable.

I. Dampers: Radial opposed blade or Combination damper and grid.

J. Accessories:
1. Equalizing grid.
2. Plaster ring.
3. Safety chain.
4. Wire guard.
5. Sectorizing baffles.
6. Operating rod extension.

2.2 LOUVER FACE DIFFUSERS

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. METALAIRE, Inc.
2. Price Industries.
3. Titus.
4. Tuttle & Bailey.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Aluminum as indicated on drawings

D. Finish: Baked enamel, white.

E. Face Size: As indicated on drawings.

F. Mounting: Surface, Surface with beveled frame, or T-bar.

G. Pattern: Adjustable core style.

H. Dampers: Radial opposed blade.

I. Accessories:
1. Square to round neck adaptor.
2. Adjustable pattern vanes.
3. Throw reducing vanes.
4. Equalizing grid.
5. Plaster ring.
6. Wire guard.
7. Sectorizing baffles.
8. Operating rod extension.

PART 3 - EXECUTION

3.1 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.

3.2 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 SUMMARY

A. Section Includes:
1. Adjustable blade face registers and grilles.
2. Fixed face registers and grilles.

B. Related Requirements:
1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ADJUSTABLE BLADE FACE REGISTERS AND FIXED FACE REGISTERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Krueger.
2. METALAIRE, Inc.
3. Price Industries.
4. Titus.
5. Tuttle & Bailey.

B. Characteristics and requirements shall be basis of design according to the equipment scheduled in the drawings.

2.2 GRILLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Krueger.
2. METALAIRE, Inc.
3. Price Industries.
4. Titus.
5. Tuttle & Bailey.

B. Characteristics and requirements shall be basis of design according to the equipment scheduled in the drawings.

PART 3 - EXECUTION

3.1 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.

3.2 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 37 23

HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hooded ventilators.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For gravity ventilators.
   1. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
   2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-framing plans and other details, drawn to scale, and coordinated with each other, based on input from installers of the items involved:

B. Welding certificates.

1.4 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."

1.5 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator 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: ASCE-7 (latest version per Authority Having Jurisdiction and per latest local Building Code).

B. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. ASHRAE 62.1 Compliance: Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
   1. Temperature Change (Range):
      a. Ambient: 100 deg F.
      b. Material Surfaces: 150 deg F.

E. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

2.2 FABRICATION

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 HOODED VENTILATORS

A. Description: Hooded rectangular penthouse for intake or relief air.

B. 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. Acme Engineering & Manufacturing Corp.
   2. Greenheck Fan Corporation.
   3. Loren Cook Company.
   4. Twin City Fan & Blower.

C. Construction:
   1. Material: Aluminum, of thickness required to comply with structural performance requirements, but not less than 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.
   2. Insulation: R8.
   3. Bird Screening: Aluminum, 1/2-inch- square mesh or flattened, expanded aluminum, 3/4-inch diamond mesh wire.
   4. Insect Screening: Aluminum, 18-by-16 mesh wire.

D. Dampers:
   1. Location: Curb damper tray.
   2. Tray: Provide damper tray or shelf with opening of size indicated.

E. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
   1. Configuration: Self-flashing without a cant strip, with Built-in raised cant and mounting flange.
   2. Overall Height: 12 inches.

2.4 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, 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 A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.

E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
   1. Use types and sizes to suit unit installation conditions.
   2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined

by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Secure gravity ventilators to roof curbs with zinc-plated hardware. Use concealed anchorages where possible.

C. Install gravity ventilators with clearances for service and maintenance.

D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealers" for sealants applied during installation.

F. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes, so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

END OF SECTION

SECTION 23 51 23

GAS VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Listed double-wall vents.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of 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.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Sample Warranty: For special warranty.

1.4 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.

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

A. 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.

B. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.

C. Inner Shell: ASTM B 209M, Type 3003 aluminum.

D. Outer Jacket: Galvanized steel.

E. 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: Round chimney top designed to exclude minimum 98 percent of rainfall.

2.2 LISTED SPECIAL GAS VENTS

A. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.

B. Construction: Inner shell and outer jacket separated by at least a 1/2-inch airspace.

C. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

D. Outer Jacket: Aluminized steel.

E. 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: Round chimney top designed to exclude minimum 98 percent of rainfall.
   2. Termination: Exit cone with drain section incorporated into riser.

PART 3 - EXECUTION

3.1 APPLICATION

A. Listed Type B and BW Vents: Vents for certified gas appliances.

B. Listed Type L Vent: Vents for low-heat appliances.

C. Listed Special Gas Vent: Condensing gas appliances.

3.2 INSTALLATION OF LISTED VENTS

A. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Lap joints in direction of flow.

E. 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 52 31

VEHICLE EXHAUST REMOVAL SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.2 SUMMARY

A. Provide all labor, materials, and equipment necessary to put in working operation a complete turnkey system to remove both diesel and automotive exhaust gases and particulate of operating vehicles. All necessary controls, motors, fittings, ductwork, blower(s), labor and all other equipment and materials specified shall be part of the work.

B. Section Includes:
1. Exhaust System General Components
   a. Support Legs.
   b. Upper Flexible Hose.
   c. Lower Hose Assembly.
   d. Safety Disconnect Coupling.
   e. Collection Nozzle Assembly.
   f. Manual Fill Valve.
   g. Hose "Saddle" Rigid Elbow
   h. Electrical Controllers.
   i. Air Moving Devices.
   j. Ductwork System.
2. Straight Rail Specific Components
   a. Rail Material.
   b. Top Mounting Suspension.
   c. Mechanical Brake System.
   d. Rail Splicing Joint.
   e. Middle Rail Duct Connection.
   f. Trolley Assembly.

C. All items of equipment and materials described in these specifications are to be furnished installed and placed into proper operating condition in accordance with good practice and manufacturer's written or published instructions.
1. The exhaust removal system shall provide virtually 100 percent complete evacuation of all diesel fumes at the source. Source locations are fixed and as located on plans.
2. System must be designed and installed to NIOSH recommendation, specifying that occupational exposures to carcinogens be limited to the lowest feasible concentration. Exposure in the human breathing zone should be limited to lowest

feasible level, without any time delay required for the system to effectively capture the diesel fumes.

3. System must also be capable to provide virtually complete capture and evacuation of carbon monoxide emitted as part of the vehicle exhaust.
4. Systems that solely use filters, in which diesel particulate may accumulate, and that would potentially have to be treated as hazardous materials, will not be accepted.
5. System must meet the guidelines for the International Mechanical code for Source Capture Systems. Such system is defined as a mechanical exhaust system designed and constructed to capture air contaminants at their source and to exhaust such contaminants to the outdoor atmosphere.
6. Hose loops shall not hang any lower than six feet from the bay floor. The hose assembly shall not come into contact with the vehicle other than one connection point to the vehicles' tailpipe. The hose assembly shall not touch or drag on the bay floor.
7. The exhaust system shall not block doorways, exits, and aisles.
8. The exhaust system shall not need to be disconnected from the vehicle while shore lines are connected, during battery charging, or washing of the vehicle, as with other types of systems.
9. The system must be designed and capable of capturing virtually 100% of the exhaust gas and virtually 100% of the particulates.
10. The system shall capture the exhaust gases and particulate directly from the tailpipe by a direct connected "visible" high temperature rated hose.

1.3 SUBMITTALS

A. Product Data: Indicate manufacturer's model number, technical data including description of components and static pressure/air flow chart, and installation instructions.
   1. Details of wiring for power differentiating between manufacturer-installed and field-installed wiring.

B. Closeout Submittals: Operation and Maintenance data manual including spare parts list.

1.1 QUALITY ASSURANCE

A. Engage a factory certified installer to perform work of this Section who has completed installations similar in design and extent to that indicated for this Project, and who has a record of successful in-service performance. No Exceptions.

B. The manufacturer must be a ISO 9001:2000 certified (www.iso.org) manufacturer with certification issued to a United States facility, this shows a commitment to delivering the highest quality service and products to the end user. Manufacturer shall be UL and CUL Certified (www.ul.com/database) and certified by the Air Movement and Control Association (AMCA) (www.amca.org/search.htm) to ensure quality, consistency and reliability of products. All certification documents shall be provided and attached to the bid proposal.

C. Engage a firm experienced in manufacturing vehicle exhaust systems similar to that indicated for this Project and with a record of successful in-service performance.

D. Conduct conference at Project site. Review methods and procedures related to vehicle exhaust system installation.
1. Review access requirements for equipment delivery.
2. Review equipment storage and security requirements.
3. Inspect condition of preparatory work performed by other trades.
4. Review structural loading limitations.
5. Review that all components specified in this Section and related components specified in other Sections are accounted for.

1.2 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading: Deliver components with protective packaging. Store in original protective crating and covering and in a dry location.

1.3 PROJECT/SITE CONDITIONS

A. Existing Conditions: Verify dimensions installation areas by field measurements.

1.4 COORDINATION

A. Coordinate layout and installation with other work, including light fixtures, fixed equipment and work stations, HVAC equipment, and gas detection system components.

B. Coordinate location and requirements of service-utility connections.

1.5 REFERENCES

A. Air Movement & Control Association International, Inc.
1. AMCA Standard 500-D-98, "Laboratory Methods of Testing Dampers for Rating".

B. ASTM International.
1. Stainless Steel:
a. A240/A240M-04ae1 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
b. Bright, Directional Polish: No. 4 finish.

C. Aluminum:
1. B209/209M-04 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
2. Powder-Coated Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

D. Galvanized Steel:
1. A653/A653M-04a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

PART 2 – PRODUCTS

2.1 MANUFACTURER shall be subject to compliance with these documents and shall be as listed below or an approved equivalent.

A. Air Cleaning Technologies, Inc.

2.2 EXHAUST SYSTEM GENERAL COMPONENTS

A. Support Legs
1. Manufactured and provided by the supplier of primary exhaust removal system (Equipment Manufacturer).
2. Support Leg Material: Aircraft aluminum alloy Type AA-6063 (ASTM B209/B209M). Supports: Standard in 19 feet lengths. A minimum of one support with appropriate bracing shall be provided for every 10 lineal feet (3 m) to 12 linear feet (3.7 m) of rail profile. The support legs shall consist of a square outer profile with dimensions no less than 2-inch (50.8 mm) OD by 0.1 inch (2.54 mm) by with 0.4 inch (10 mm) fastening hardware provided.
3. The vertical adjustable mounting foot shall be capable of attaching the leg assembly to a ceiling with a 30-degree pitch, complete with 3/8-inch (9.5 mm) hardware necessary for mounting the leg assembly to the top suspension mount. The support leg shall be equipped with round tubular zinc-plated steel knee brace with pressed ends in standard lengths of 20 inch (508 mm), 30 inch (762 mm) and 7- inch (1828.8 mm). The angle shall be completely adjustable to the leg support and mounted perpendicular and parallel to direction of the rail. The typical support angle shall be 45 degrees from the centerline of the factory provided support leg. The standard leg shall be capable of meeting a Seismic Zone 4 requirement. Vertical support and bracing shall be provided to safely secure the rail profile in accordance with building code and seismic standards which may apply. A minimum of one support with appropriate bracing shall be provided for every 10 lineal feet (3 m) to 12 linear feet (3.7 m) of rail profile.

B. Upper Flexible Hose
1. Upper Hose: Flexible exhaust hose manufactured for the sole purpose of venting high temperature exhaust gases.
2. Flexible Hose: Designed strictly for the harsh environment of rapid response and auto-release of a vehicle exhaust tailpipe.
4. Hose: Range from 4-inch (101.6 mm) to 5-inch (127 mm) diameters with length of 25 feet (7.6 m) without joining or splicing connections. Hose Material: High temperature synthetic rubber impregnated into a high temperature laminated fabric with a minimum overlapping thickness of 2-7/16 inches (61.9 mm). This construction of hose must be capable of operating at continuous temperatures of 400 degrees F (204 degrees C) and intermittent temperatures of 500 degrees F

(260 degrees C) such as are experienced when pump checks are performed inside the station.

5. Wire Helix: Bound and protected in laminations of hose winding. This shall be accomplished in a fashion which eliminates any possibility of personnel coming in contact with an exposed hot metal helix. The hose shall further protect the internal wire helix from heat buildup and in turn add increased visibility to personnel.
6. Wear Strip: 9/16 inch (14.28 mm) wide and be provided as a safety yellow color. The bend radius of the high temperature hose shall be no less than 1.5 times the diameter of hose to ensure that hot gases are not restricted as they pass through the system.

C. Lower Hose Assembly

1. Lower Hose: Rigid 4-inch (100 mm) or 5-inch (125 mm) diameter by 2 ft. (610 mm) long section of yellow and black hose identical in appearance to the upper hose assembly. This construction of hose must be capable of operating at continuous temperatures of 400˚ F (204˚ C) and intermittent temperatures of 500˚ F (260˚ C) such as are experienced when pump checks are performed inside the station. Supports the magnetic collection nozzle and stainless steel reducing elbow in a rigid fashion to allow for the operator to place hose collection nozzle onto the tailpipe without bending over. The lower hose is the only section of hose which shall disconnect from the upper hose assembly and act as a safety disconnect in the unlikely event the nozzle gets entangled. Hoses utilizing an exposed metal helix will not be acceptable due to potential burn hazard. No exceptions will be allowed.

D. Safety Disconnect Coupling

1. Safety Disconnect Coupling Handle (SDCH): An injection molded composite body with a 4-inch (100 mm) or 5-inch (125 mm) diameter hose connection. A 360-degree rubber bumper to protect the vehicle and disconnect from wear shall be incorporated in the design of the system.
2. Coupling: Consists of a aluminum inner flange collar connected by a patented easy reconnect mechanism. The release tension of this device shall be preset at 84 pounds of force (375N). And easily reconnected with only 3 pounds of force (13N).

E. Collection Nozzle Assembly: Provides a substantially air tight seal around exhaust tail pipe when connected thus allowing for virtually 100% source capture. The seal shall limit escape of life threatening exhaust gases which may be present during the following conditions:

a. In the event vehicle's engine is accelerated above normal idle resulting in an exhaust velocity greater than 5000 feet per minute (25.4 meters per second).
b. In the event that the output velocity or CFM of the exhaust exceeds the manufacturers normal capture velocity or CFM of exhaust system.

1. Optional Magnetic Nozzle: Exhaust system nozzle (female connection) specifically designed to fit tightly over the circumference of an engineered conical mating ring (male connection) that attaches to the tail pipe and attaches tightly

around the ring to capture virtually 100% of the carcinogenic diesel exhaust. Nozzle shall be typical at all drops.

2. The Stainless-reducing elbow that connects to the connection nozzle shall be fabricated using continuous welded construction. Angle of Transition: No less than or greater than 67 degrees from the centerline of the reducer. stainless Reducer: Incorporate a primary expanded metal debris screen, which is permanently affixed by welded seams to the inside, opening of exhaust fitting.

F. Hose Suspension Saddle: Fabricated of chrome steel specifically manufactured for the sole purpose of suspending high temperature exhaust ventilation hose in a rapid response and auto-release application. The design of the saddle shall smoothly transition the direction of the hose during its travel along the track. Securing clamps shall be provided including a link fastener, for the purpose of mounting it to the balancer safety link.

G. Electrical Controllers

1. Controller: Built and supplied by a UL recognized and listed exhaust system manufacturer. Controller shall carry the UL - CUL listing label as an "Enclosed Industrial Control Panel." Individual components listed by UL - CUL shall not satisfy the above requirement. Manufacturer shall undergo monthly inspections by UL to verify all requirements and standards are met as outlined by UL. The controller shall be delivered as an Operating System Three series controller or an approved equal to the specifications to follow.
2. Electrical Controllers: Bear a visible UL listing label as proof of subscribership and shall be validated by UL as an "Enclosed Industrial Control Panel". Certification documents shall accompany bid documents.
    a. Manufacturer Name &Address
    b. UL File Number
    c. Electrical controller and manufacturer shall be recognized and listed by UL. Controller shall be manufactured in accordance with Underwriters Laboratories standard UL-508 for "Enclosed Industrial Control Panels". The electrical controller shall include a Class 1 limited energy control circuit. Enclosures shall be NEMA 12 rated and UL listed as Type 12. The electrical control components shall be provided and mounted in an electrical enclosure to restrict access to internal components of the controller by authorized personnel only.
3. Controller Performance: Designed to sense the output pressure and temperature change inside the ductwork system, which is normally generated by any internal combustion engine designed to propel a motor vehicle. The operating logic shall be designed to complete this cycle. At any point in time when a collection device is connected to a motor vehicle's exhaust tailpipe, as the operator starts the vehicle, the controller shall automatically sense the engine's output pressure or temperature of the exhaust and in turn energize the electrical contractor which will supply power to the AMCA certified spark resistant fan motor. If the responding vehicle does not disconnect from the exhaust ventilation system in less than the designated setting, the temperature override switch shall override the time delay to ensure continuous system operation. This automated function will work for as long as the exhaust gas temperature is in excess of the setting on the heat sensor located in the ductwork system. This cycle shall not allow the electrical contractor, which energizes the

exhaust fan, to short cycle or stop the fan while the system is connected to an operating vehicle.

4. Motor Control Contactor: Allen Bradley Industrial Electrical Contactor 100C series. The contactor shall be UL - CUL listed as an approved component.
5. Motor Control Overload Relay: Allen Bradley 193 ES series. Overload relay shall have an adjustable trip range to meet the proper full load amperage of the blower motor.
6. Soft Touch Controls: Incorporated on the face or the access door of the controller by the use of an adhesive backed Lexan membrane type label to prevent water infiltration, which would void the NEMA 12R rating. Label: Provided and secured permanently to the exterior of the electrical controller. Label: Include the name of the manufacturer, address, telephone number, user instructions and any warnings or cautions required by Underwriters Laboratories.
7. Auto Start: This mode of operation shall be strictly for normal day use, as it would apply to receiving an emergency call and leaving the station. Any one or combination of the three devices listed below in Paragraph H shall activate the system. The system shall maintain itself in the Auto Start mode and always return there after the Stop sequence has been initiated.
8. Stop: This mode of operation shall be a system override to shut down the system manually. Upon activating this mode of operation, the exhaust system blower shall shut down.
9. This mode of operation shall be a system override to run the exhaust system blower continuously for the purpose of running the vehicles indoors for equipment checks during inclement weather. Upon activating this mode of operation, the exhaust system blower shall start and run continuously until the Stop mode is activated.
10. System Indicator LED's: Show system status at all times.
    a. Auto Start Indicator: Indicate the system is in the fully automatic mode of operation and that power is on to the controller.
    b. Fan On Indicator: Indicate that power is being applied to the system blower and the controller is operating normally.
    c. Filter Status Indicator: Indicate, if flashing, excessive pressure loss across the filter bank media. Consequently the filter must be serviced to maintain optimum efficiency of the system.
    d. Stop Indicator: Indicate the fan has been manually de-energized and will return to the Auto Start ready sequence in less than three seconds to prevent the system blower from being left in the Off mode.
    e. Manual Run Indicator: Indicate the fan is operating in a continuous run mode until interrupted by the stop mode activation.
11. Controller Transformer: UL listed industrial control circuit transformer sized to properly supply all components so that only one transformer shall be required. Transformer shall be provided with multi-tap primary for 115, 208, 240, 277, 400, 480, and 600VAC, and 24, 120, 230VAC secondary operating on 50 or 60 hertz with a capacity of 90-volt amperes.
12. Control Circuit Protection: By the use of primary and secondary fuses (NEC code ref. 430-72) to meet UL requirements. The primary shall be protected by a pair of FLQ style fuses rated at 1.6 amps for voltages under 400V and a pair of .75 amp fuses for voltages over 400V. The primary fuse holder shall have a standard

indicator light feature to aid in troubleshooting blown fuses. A single glass fuse rated at 3 amps at 250V shall protect the secondary side of the control circuit.

13. Electronic Control Circuit Card: Solid state printed circuit board. The soft controls shall be an integral part of the control circuit card. The control circuit card shall utilize a potentiometer to adjust the length of the timing cycle from 7 to 360 seconds. It shall incorporate several different modes of operation and optional features.
14. Activation Devices:
    a. Engine Start Switch: An engine pressure sensing type, capable of recognizing the output pressure of any type of motor vehicle exhaust. The electrical contact shall be dry type or not to exceed 24V ac. There shall be one sensor per vehicle.
    b. Thermal Start Switch: Temperature sensing switch of the snap disc type and adjustable from 90 degrees F (32 degrees C) to 130 degrees F (55 degrees C) to configure the system based on different exhaust temperatures. There shall be one sensor per vehicle.
15. Clean Filter Indicator Alarm: Used in conjunction with the optional Unifilter for filtering diesel exhaust particulate before release to the atmosphere. The clean filter indicator shall monitor the pressure loss across the filter bank media. Once the useful life of the filter has been depleted the pressure differential switch will signal a high-pressure loss and flash the "Fan On" indicator while the exhaust blower is running.
16. Electrical Wiring: Run in wire channel to allow for easier identification of the wiring circuits and for a neat appearance. All wiring circuitry shall meet International Electrical Code and UL standards for proper size, bending radiuses (International Electrical Code) and terminations.
17. Electrical Terminal Block: 600 V, UL rated and recognized. It shall provide individual connection points for remote controls, clean filter indicator and power connections. The primary and secondary control wiring fuses shall be incorporated into the terminal block as one unit.
18. Product Manual: Shall be provided with each electrical control box supplied. The product manual shall include a description of components with part numbers inclusive to the controller. It shall include a wiring schematic showing all internal circuitry as well as all field installed wiring connections to the controller.

H. Electrical System

1. Station Electric Supply Panel: The power circuit for the "Emergency Response Vehicle Exhaust Removal System" shall originate in a circuit breaker panel board of the appropriate size to handle the load. Fan circuit shall be supplied by a UL listed, HACR rated circuit breaker (HACR rating is specifically for motor type loads) of the same type as indicated by the manufacturer of the circuit breaker panel or a dual element time delay fuse for fuse style panels. The circuit shall be clearly marked on an engraved ledger plate or in ink on the panel schedule.
2. OS-3 Automatic Controller: Built and supplied by a UL recognized and listed exhaust system manufacturer. Controller shall carry the UL - CUL listing label as an "Enclosed Industrial Control Panel". Individual components listed by UL shall not satisfy the above requirement. Manufacturer must undergo monthly

inspections by UL to verify all requirements and standards are met as outlined by UL. The controller shall be delivered as an Operating System Three series controller or an approved equal to the specifications in 2.17 Electrical Controllers. The controller shall be mounted 6 feet (1829 mm) to the top of the cabinet AFF (above finished floor). A safety disconnecting means must be within sight of the controller for servicing and for safety reasons. If the supply panel is not within sight, a separate disconnecting means is required beside the controller (NEC code ref. 430-102 (a). Safety disconnect shall be capable of being locked in the off and on position to follow lockout, tag out procedures. See attached Table 1-1 for proper Square D part number of safety disconnect switch.

3. Power Wiring Conduit: Minimum of EMT utilizing compression type fittings for damp locations (International Electrical Code). Conduit shall be supported with a conduit strap every 10 feet (3 m) and within 3 feet (914.4 mm) of each box or termination, (International Electrical Code and local modifiers.).
4. Power Wiring from Supply Panel to OS-3: THHN stranded copper wire consisting of a flame retardant, heat-resistant thermoplastic insulation with a nylon jacket for abrasion, gas, and oil resistance and rated up to 600 volts.
5. Low Voltage Control Wiring: Minimum of a 14/2 multi-conductor shielded cable (Anixter part number #2AS-1401POS or equivalent) to meet UL standards for the controller's low voltage field wiring. Termination procedure shall be as follows; the shielded cable shall be stripped back inside the control cabinet, the mylar foil shield and silver drain wire are to be twisted together and secured under the screw in the grounding lug inside the control cabinet. Terminations at each sensor must leave foil shielding and drain wire intact and at no point shall it come into contact with ground. There shall be only one connection to ground.
6. Power Wiring from OS-3 to Fan Motor: Minimum of EMT utilizing compression type fittings for damp locations (NEC code ref.348-10). Conduit shall be supported with a conduit strap every 10 feet (3048 mm) and within 3 feet 914.4 mm) of each box or termination (International Electrical Code and local modifiers.). Conduit shall extend through the outside wall through a hole of the proper size and terminate directly into the back of the safety disconnect with the appropriate connector and sealed with a silicon sealer or cement mortar. (Using fan model number select appropriate wire and conduit size from Table 1-1).
7. Fan Safety Disconnect: Square D (or equivalent), non-fusible, NEMA 3R rated for wet locations, mounted adjacent to the AMCA Certified blower. Safety disconnect shall be capable of being locked in the off and on position to follow lockout, tag out procedures. (Using fan model number select appropriate safety disconnect from attached Table 1-1).
8. Liquid Tight Flexible Metal Conduit: UL listed liquid tight flexible metallic conduit (Sealtite). Conduit will encase the load wires and ground wire from the safety disconnect switch to the blower motor. Conduit length not to exceed 4 feet (1219.2 mm) from disconnect to blower motor. The appropriate listed terminal fittings shall be used. (NEC code ref.351-7) (Using fan model select appropriate conduit size from attached Table 1-1).
9. Spark Resistant Blower: AMCA certified, designed and installed as a direct drive spark resistant blower (IMC code ref. 503.2) The motor shall meet current EPACT standards for energy savings. Fans utilizing steel housings and impellers will not be accepted.

10. Temperature Switch: The temperature switch shall be of the snap disc type and adjustable from 90 degrees F (32 degrees C) to 130 degrees F (54 degrees C). It shall be mounted on the ductwork 2 inches (50.8 mm) above the pressure switch by drilling a 1-inch (25.4 mm) hole, sealing the switch with silicon sealant and securing with 2 tek screws. Electrical connection shall be made with terminals provided or solder less type such as Thomas & Betts part no. 14RB-2577 or equivalent.
11. Pressure Switch: The pressure switch shall operate at a maximum of 24VAC, pre-calibrated at .18 in. of water column. Mounting shall be accomplished by drilling a 3/8-inch (9.5 mm) hole 3 inches 76.2 mm) above the riser bracket and to the left of the regulator and threading the switch into the duct. The electrical connections shall be made with a 0.020-inch (.5 mm) by 0.187-inch (4.8 mm) female quick disconnect terminals, such as Thomas & Betts part no. 14RBD-18277 or equivalent.

I. Air-Moving Devices
1. Centrifugal Fans: Direct drive centrifugal type, high pressure, single width, and single inlet as required or indicated. Impeller Wheels: Backward incline design for high static pressure performance, spark resistance and made of Aluminum. The impeller shall be dynamically and statically balanced and of the non-overloading type to provide maximum efficiency while achieving quiet, vibration-free operation. The fan housing shall be manufactured from aluminum AA-1050A material or equivalent with an aluminum, finish. The outlet configuration shall be top horizontal, bottom horizontal, or upblast. The housing shall be capable of field reconfiguration in the event the mounting position needs to be changed for unforeseen reasons.
2. Fan Motor and Bearing: All 1 horsepower (746 watts) to 15 horsepower (11190 watts) motors shall be totally enclosed fan cooled (TEFC) continuous duty rated. The motors shall be dual voltage where applicable. Motors shall comply with the government mandated “Energy Policy and Conservation Act” (EPACT) as outlined by the Department of Energy. The bearings shall be self-aligned, ball bearing type permanently sealed and lubricated. The exhaust discharge outlet shall be in compliance with International Mechanical Code and ACGIH recommendations (min. of 36" above roofline). Air intakes, windows, cascade systems, prevailing currents, communication equipment and building aesthetics shall be considered in the final location of the fan.
3. Teflon Shaft Seal: The fan shaft shall be steel and rotate in a non-sparking TEFLON seal to prevent leakage and to prevent hot exhaust gases from coming into contact with the motor bearings.
4. Variable Speed Drive: The motor shall be compatible with a variable speed drive unit.
5. Performance: The delivered volume shall take into account all the static regain of vehicle engine exhaust (based on an airtight connection at the tailpipe), lengths of ductwork, elbows, branches, shut off, wyes, etc. which accumulate the static pressure at the field inlet. The manufacturer’s provided fan(s) shall be performance guaranteed.
6. Fan Capacity: The Fan Capacity shall be sized as such as to deliver the required CFM at each hose drop to which the vehicle is attached.

a. The 4-inch (101.6 mm) hose system shall be designed to deliver a minimum of 500 CFM (2.9 M/Second) at a velocity of 5800 FPM (33.6 M/Second) at the hose and nozzle connection.
b. The 5-inch (127 mm) hose system shall be designed to deliver a minimum of 750 CFM (4.4 M/Second) at a velocity of 5800 FPM (33.6 M/Second) at the hose and nozzle connection.
c. The 6-inch (152.4 mm) system shall be designed to deliver a minimum of 1100 CFM (6.4 M/Second) at a velocity of 5800 FPM (33.6 M/Second) at the hose and nozzle connection.

J. Ductwork System
1. Ductwork Type and Materials:
a. Interior Duct shall be Torit "Easy Duct" system galvanized construction.
b. Exterior Duct shall be Torit "Easy Duct" system galvanized construction.
2. Ductwork Sizing and Gauges: Round pipe construction, with the range of available sizes not to exceed 10 inches (254 mm) in diameter. Duct gauge shall depend on diameter and a minimum operating pressure of 8 inches water gauge (1990 Pa). Acceptable Gauge and Reinforcement Requirements: Inner duct diameter 4 inches (101.6 mm) through 11 inches (279.4 mm) diameter shall be 22-gauge standard pipe (International Mechanical Code).
3. Ductwork Fittings: Round and have a wall thickness 2 gauges (one even gauge number) heavier than the lightest allowable gauge of the downstream section of duct to which they are connected (International Mechanical Code). Air Duct Branch Entrances: Factory fabricated fittings or factory fabricated duct /tap assemblies. Fittings: Constructed so that air streams converge at angles no greater than 45 degree (International Mechanical Code). All Seams: Continuous stitch welded and if necessary internally sealed to ensure air tightness. Turning elbows shall be stitch-welded and used for all diameters and pressures. They shall be fabricated of 20 gauge-galvanized steel and constructed as two-piece with continuous welded seam construction fittings similar to those provided by Lindab Inc. Tapered Body Fittings: Used wherever particular fallout is anticipated and where airflow is introduced to the transport duct manifold.

K. Ductwork Design Velocities: Minimum of 3500 FPM (20.3 M/Second) to 4000 FPM (23.2 M/Second) transport velocity. Capture Velocity: 5500 FPM (31.9 M/Second) to 6000 FPM (34.8 M/Second) to extract 100 percent of the exhaust gases.

L. External Ductwork: Sized for the exact inlet and outlet of the exhaust fan blower. An exhaust rain cap shall be supplied and manufactured in accordance with EPA standard for free draft rain cap requirements. Included as an integral part of this rain cap shall be a back draft damper to provide protection from rain and other inclement weather.
Exhaust Penetrations: The core drilling shall be properly sized to reduce the diameter of the smallest opening size.

2.2 STRAIGHT RAIL SPECIFIC COMPONENTS

A. Rail Material: One-piece continuous extruded aluminum rail in a minimum length of 19 feet (5791.2 mm) in an effort to reduce the points of leakage due to seams or connections. The

construction profile shall be of a round profile type, diameter of 6.5 inches (165.1 mm) with a rail thickness of 0.175 inch (4.5 mm). The bottom portion of the rail shall have a continuous slot to accept a rubber seal. Rail Material: Aircraft aluminum alloy Type AA-6063 (ASTM B209/B209M). Aluminum Rail: Extruded as a one-piece design unit to maximize the structural integrity of the rail and to minimize joints. Extruded into the rail profile shall be all necessary mounting guides, which will allow for support of the rail mounting hardware and airline support cable. Mounting Channels: Provided continuously along both sides of the rail extrusion in order the proper positioning of all required mounting supports in accordance with codes. The rail shall allow the trolley/hose assembly to glide to the door threshold in a safe and effective manner. The extruded rail channel shall allow the whole rail to remain rigid and shall provide an area to attach bolts for splicing additional rails together for systems over 19 feet (5791.2 mm) long. The overall extruded rail lengths shall be 19 foot (5791.2 mm) standard. Rail System: Equipped with a hydraulic braking system that limits travel of flex hose as the vehicle exits the building. Hydraulic Brake: Incorporated into the end cap of the suction rail.

B. Top Mounting Suspension: Designed to attach with 2 mounting cleats to the mounting slots that were extruded into the rail profile.

C. Mechanical Brake System: Incorporated into the end cap of the suction rail profile. The mechanical brake system must incorporate a pair of composite shock "bumpers" capable of reducing the forward impact of 1 to 4 suction trolleys which may be installed now or in the future to the exhaust rail system. This mechanical shock system shall be secured to a steel end cap fabricated of 6.25-inch (158.8 mm) diameter steel tubing with a wall thickness of 0.156-inch (4 mm) welded to a 0.156 inch (4 mm) steel plate with formed 90 degree side rails for rigidity. The end cap shall have a removable circular end plate to facilitate an end feed duct connection and shall be a black powder coated finish. The mechanical shock shall be capable of reducing to a full stop the trolleys in less than 4 inch (101.6 mm), without physical damage to either the rail profile or trolley that it is stopping.

D. Rail Splicing Joint: The splice joint shall be formed aluminum extrusion equal to the internal diameter of the suction rail profile. The splice shall have a wall thickness of no less than .190 inches (4.8 m) in thickness and a length of no less than 8 inches (203.2 mm) from end to end. The rail splicing shall be safely secured by no less than 12- 3/8-inch 314.3 mm) by 1-½ inch (38.1 mm) bolts, nuts and lock washers. Each bolt shall pass through the exterior of the rail profile and splicing joint and be secured on the inside by a lock washer and nut. Self-tapping bolts or screws are not acceptable.

E. Middle Rail Duct Connection: The rail duct connection shall be rectangular to an 8-inch diameter round transition fitting fabricated from 24 gauge galvanized steel (ASTM A653) with a double rubber U style lip seal. The rectangular slot shall be 19 inch (482.6 mm) long by 1-¾ inch (44.5 mm) high with a 3/8-inch (9.5 mm) external flange to slide into the rail profile.

F. Trolley Assembly: Gantry type trolley with sealed bearing loaded wheels designed to roll inside the internal rail profile flange. The trolley chassis shall be galvanized steel (ASTM A653) epoxy coated with a black finish. The chassis shall be fitted with a tapered cone. Rubber Sealing Lips: Vulcanized Teflon strip covering 1-½ inch (38.1 mm) of the bottom

edge of the sealing lip which shall minimize resistance between the cone and the rubber sealing lips. The exhaust cone transition shall be a tapered slot design which shall fit inside the suction rail profile. The tapered slot shall be equal or exceed in area the diameter of exhaust ventilation hose to which it is attached. Trolley Assembly: Equipped with rubber impact bumpers at both the front and rear of the trolley chassis to eliminate metal-to-metal contact which could damage the trolley assembly. There shall be a system balancer assembly provided to aid in the delivery of the hose to the exit door. Balancer Assembly: Self-adjusting weight spring tension balancer with a lifting capacity of no less than 31 pounds (31 KG). The balancer shall have a minimum diameter steel cable of .080 inch (2 mm) and have a safety link connection.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide surface/substrate preparation as required by the manufacturer's printed installation instructions. Do not proceed with installation is in proper condition to receive vehicle exhaust system installation.

3.2 INSTALLATION

A. Install vehicle exhaust system in accord with manufacturer’s written instructions, original design and referenced standards.

3.3 ADJUSTING

A. Adjust vehicle exhaust system for proper operation. Replace any parts that prevent the system from operating properly.

3.4 CLEANING

A. Remove all debris caused by installation of the vehicle exhaust system. Clean all exposed surfaces to as fabricated condition and appearance.

3.5 PROTECTION

A. Provide protection of the completed installation until completion of the project. Repair any damage at no additional cost to Owner.

3.6 TRAINING

A. Provide training to personnel in the daily use and maintenance of the vehicle exhaust removal system that has been installed and specified herein. Owner shall be notified at least 7 days prior to the date scheduled for the training course. Training shall be for all personnel involved with the operation of the exhaust removal system to include all shifts required to man the particular facility. The Training session shall be performed in person by a recognized representative of the manufacturer of the exhaust removal system, in addition a training video shall be provided.
   1. Provide training to all shifts during their normal shift period.

3.7 WARRANTY

A. Provide a written warranty for a period of five (5) years from date of shipment for all components including fan, motor and controls. Warranty shall be parts and labor to replace a defective part. Service shall be accomplished by a factory trained technician.

END OF SECTION

SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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.

1.6 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.

1. Warranty Period:
   a. For Compressor: Five year(s) from date of Substantial Completion.
   b. For Parts: Five year(s) from date of Substantial Completion.
   c. For Labor: Five year(s) from date of Substantial Completion.

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. Carrier Corporation.
   2. Daikin.
   3. LG.
   4. Lennox
   5. Trane.
   6. YORK; a Johnson Controls company.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:
   1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
   2. Insulation: Faced, glass-fiber duct liner.
   3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
   4. Gas Furnace:
      a. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
      b. CSA Approval: Designed and certified by and bearing label of CSA.
      c. Burners: Stainless steel.
         1) Rated minimum turndown ratio: 2 to 1.
         2) Fuel: Natural gas.
         3) Ignition: Electronically controlled electric spark with flame sensor.
         4) Gas Control Valve: Two stage.
         5) Gas Train: Regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, electronic-modulating temperature control valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
      d. Venting, Gravity: Gravity vented.
      e. Combustion-Air Intake: Separate combustion-air intake and vent terminal assembly.
      f. Heat Exchanger: Stainless steel.
      g. Heat-Exchanger Drain Pan: Stainless steel.
      h. Safety Controls:
         1) Gas Manifold: Safety switches and controls complying with ANSI standards.
         2) Vent Flow Verification: Differential pressure switch to verify open vent.
         3) High Limit: Thermal switch or fuse to stop burner.

4) Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
5) Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
6) Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
7) Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.
8) Control Transformer: 24 V ac.

5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
   c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Filters: Permanent, cleanable.
9. Condensate Drain Pans:
   a. Fabricated with two 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. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
   c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
      1) Minimum Connection Size: NPS 2.
   d. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Floor-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
   a. Discharge Grille: Steel with surface-mounted frame.
   b. Insulation: Faced, glass-fiber duct liner.
   c. Drain Pans: Galvanized steel, with connection for drain; insulated.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Gas Furnace:
   a. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.

b. CSA Approval: Designed and certified by and bearing label of CSA.
c. Burners: Stainless steel.
1) Rated minimum turndown ratio: 2 to 1.
2) Fuel: Natural gas.
3) Ignition: Electronically controlled electric spark with flame sensor.
4) Gas Control Valve: Two stage.
5) Gas Train: Regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, electronic-modulating temperature control valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
d. Venting, Gravity: Gravity vented.
e. Combustion-Air Intake: Separate combustion-air intake and vent terminal assembly.
f. Heat Exchanger: Stainless steel.
g. Heat-Exchanger Drain Pan: Stainless steel.
h. Safety Controls:
1) Gas Manifold: Safety switches and controls complying with ANSI standards.
2) Vent Flow Verification: Differential pressure switch to verify open vent.
3) High Limit: Thermal switch or fuse to stop burner.
4) Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
5) Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
6) Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
7) Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.
8) Control Transformer: 24 V ac.

4. Fan: Direct drive, centrifugal.
5. Fan Motors:
a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
b. Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
6. Air Filtration Section:
a. General Requirements for Air Filtration Section:
1) Comply with NFPA 90A.
2) Minimum MERV according to ASHRAE 52.2.
3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
b. Extended-Surface, Disposable Panel Filters:
1) Thickness: 2 inches.
2) MERV according to ASHRAE 52.2: 7.
3) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
4) Media-Grid Frame: Nonflammable cardboard.

5) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

C. Wall-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel 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. 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: Direct drive, centrifugal.
5. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
   c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
   e. Mount unit-mounted disconnect switches within sight of unit.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
   a. Fabricated with two 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 inch deep.
   b. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
   c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on of pan.
      1) Minimum Connection Size: NPS 2.
8. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Disposable Panel Filters:
      1) Thickness: 2 inches.
      2) MERV according to ASHRAE 52.2: 7.

3) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
4) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

c. Extended-Surface, Disposable Panel Filters:
1) Thickness: 2 inches.
2) MERV according to ASHRAE 52.2: 7.
3) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
4) Media-Grid Frame: Nonflammable cardboard.
5) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:
1. Casing: Steel, finished with baked enamel in color selected by Architect, 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. 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. Two-speed 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 sub-cooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Concrete Pad.

2.4 ACCESSORIES

A. Thermostat: Wired infrared functioning to control compressor and evaporator fan, with the following features:
1. Control-voltage transformer where required to convert 120V to 24V for thermostat operation.
2. Compressor time delay.
3. 24-hour time control of system stop and start 7-day programmable.
4. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
5. Fan-speed selection including auto setting.
6. ASHRAE 130 BACnet certified and compatible for integration into BACnet system via MS/TP or BACnet IP.

7. Heat-cool-off switch.
8. Fan on-auto switch.
9. Automatic changeover.
10. Adjustable deadband.
11. Exposed set point.
12. Exposed indication.
13. Degree F indication.
14. Unoccupied-period-override push button.
15. Automatic-reset timer to prevent rapid cycling of compressor.

B. 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.

C. Drain Hose: For condensate.

D. Monitoring:
1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

2.5 CAPACITIES AND CHARACTERISTICS

A. Cooling Capacity:
1. See Schedules on the Drawings.

B. Heating Capacity:
1. See Schedules on the Drawings.

C. Indoor Unit:
1. See Schedules on the Drawings.

D. Outdoor Unit:
1. See Schedules on the Drawings.

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 033000 "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 230548.13 "Vibration Controls for HVAC."

D. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

E. Install controls and equipment shipped by manufacturer for field installation with indirect, gas-fired heating and ventilating units.

F. Install gas-fired units in accordance with NFPA 54.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Gas Piping: Comply with requirements in Section 221123 "Facility Natural-Gas Piping Connect gas piping with shutoff valve and union and with sufficient clearance for burner removal and service. Make final connections of gas piping to unit with corrugated, stainless-steel tubing flexible connectors complying with ANSI LC 1/CSA 6.26 equipment connections

C. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

D. Duct Connections: Duct installation requirements are specified in Section 233113 "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 233300 "Air Duct Accessories."

3.3 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.

B. 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.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 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 82 36

FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electric, finned-tube radiation heaters.

1.2 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 details and dimensions of custom-fabricated enclosures.
   4. Indicate location and size of each field connection.
   5. Indicate location and arrangement of piping valves and specialties.
   6. Indicate location and arrangement of integral controls.
   7. Include enclosure joints, corner pieces, access doors, and other accessories.
   8. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 ELECTRIC FINNED-TUBE RADIATION HEATERS

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. Berko; Marley Engineered Products.
   2. Chromalox, Inc.
   3. Markel Products; TPI Corporation.
   4. Marley Engineered Products.
   5. Trane.

B. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.
   1. 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. Heating Elements: Nickel-chromium-wire heating element enclosed in metallic sheath mechanically bonded to fins, with high-temperature cutout and sensor running the full length of the element. Element supports shall eliminate thermal expansion noise.

D. Front Panel: Minimum 0.0428-inch- thick steel.

E. Rust-Resistant Front Panel: Minimum 0.052-inch- thick, ASTM A653/A653M, G60 galvanized steel.

F. Wall-Mounted Back Panel: Minimum 0.0329-inch-thick steel, full height, with full-length channel support for front panel without exposed fasteners.

G. Floor-Mounted Pedestals: Conceal conduit for power and control wiring at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel.

H. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.

I. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.

J. Damper: Knob-operated internal damper at enclosure outlet.

K. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.

L. Enclosure Style: Flat top.
   1. Front Inlet Grille: Punched louver; painted to match enclosure.
   2. Front Inlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.
      a. Mill-finish aluminum.
      b. Anodized finish, color as selected by Architect from manufacturer's standard colors.
      c. Painted to match enclosure.
   3. Front Outlet Grille: Punched louver; painted to match enclosure.
   4. Front Outlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.
      a. Mill-finish aluminum.
      b. Anodized finish, color as selected by Architect from manufacturer's standard colors.
      c. Painted to match enclosure.

M. Unit Controls: Integral low-voltage relay and control transformer for remote thermostat.

N. Accessories: Integral disconnect switch, filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 FINNED-TUBE RADIATION HEATER INSTALLATION

A. Install units level and plumb.

B. Install enclosure continuously around corners, using outside and inside corner fittings.

C. Join sections with splice plates and filler pieces to provide continuous enclosure.

D. Install access doors for access to valves.

E. Install enclosure continuously from wall to wall.

F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

G. Install valves within reach of access door provided in enclosure.

H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

I. Install piping within pedestals for freestanding units.

3.2 CONNECTIONS

A. Ground electric finned-tube radiation heaters 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."

3.3 FIELD QUALITY CONTROL

A. Perform the following field 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.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 23 82 39.16

PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes propeller unit heaters with hot-water coils.

1.2 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 piping valves and specialties.
   7. Indicate location and arrangement of integral controls.
   8. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

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. CCI Thermal Technologies, Inc.
   2. Engineered Air.
   3. Reznor.
   4. Trane.

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.

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 INDIRECT-FIRED GAS BURNER

A. Description: Factory assembled, piped, and wired; and complying with ANSI Z21.47, "Gas-Fired Central Furnaces," and with NFPA 54, "National Fuel Gas Code."
   1. CSA Approval: Designed and certified by and bearing label of CSA.
   2. Burners: Stainless steel.
      a. Gas Control Valve: Modulating.
      b. Fuel: Natural gas.
      c. Minimum Combustion Efficiency: 80 percent.
      d. Ignition: Electronically controlled electric spark with flame sensor.

B. Venting: Concentric Vent – manufacturer option.

C. Combustion-Air Intake: Concentric Vent – manufacturer option.

D. Heat Exchanger: Stainless steel.

E. Safety Controls:
   1. Vent Flow Verification: Flame rollout switch.
   2. Control Transformer: 24-V ac.
   3. High Limit: Thermal switch or fuse to stop burner.

4. Gas Train: Regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, hydraulic-modulating temperature control valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
5. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
6. Gas Manifold: Safety switches and controls complying with ANSI standards.
7. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
8. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
9. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.

2.6 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

2.7 CONTROLS

A. Control Devices:
   1. Unit or Wall-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 piping and 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 with vertical-limit stop. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 230548.13 "Vibration Controls for HVAC."

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. Install piping adjacent to machine to allow service and maintenance.

B. Comply with safety requirements in UL 1995.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. 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 with the assistance of a factory-authorized service representative:
   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

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Copper building wire rated 600 V or less.
   2. Connectors, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. RoHS compliant.
   3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

D. Conductor Insulation:
   1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 CONNECTORS

A. Description: Factory-fabricated connectors and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use. Splices are not acceptable.

B. Jacketed Cable Connectors: For jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
   1. Material: Bronze.
   2. Type: Two hole with standard barrels.
   3. Termination: Compression.

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 AWG and smaller; stranded for No. 8 AWG and larger.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

D. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

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. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

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 ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm)]of slack.

D. Comply with requirements in Section 28 46 21.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. 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."

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 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. Foundation steel electrodes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
   1. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
      a. Test wells.
      b. Ground rods.
      c. Grounding arrangements and connections for separately derived systems.
   2. Instructions for periodic testing and inspection of grounding features at test wells based on NFPA 70B.
      a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
      b. Include recommended testing intervals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

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 UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

A. Insulated Conductors: 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 B3.
2. Stranded Conductors: ASTM B8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 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. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Conduit Hubs: Mechanical type, terminal with threaded hub.

G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

H. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

I. Straps: Solid copper, copper lugs. Rated for 600 A.

J. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

K. Water Pipe Clamps:
   1. Mechanical type, two pieces with zinc-plated bolts.
      a. Material: Die-cast zinc alloy.
      b. Listed for direct burial.
   2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

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 copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 30 inches (750 mm) below grade.

C. 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 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.

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 Anti-frost 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.

3.3 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 Rods: Drive rods until tops are 2 inches (50 mm) 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.

C. 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.

D. 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.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:
   1. After installing grounding system but before new 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 and ground rod, 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.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect 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 SUMMARY

A. Section Includes:
1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 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 Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
   1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   2. Material for Channel, Fittings, and Accessories: Galvanized steel.
   3. Channel Width: minimum 1-5/8 inches (41.25 mm).
   4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
   6. Toggle Bolts: Stainless-steel springhead type.
   7. Hanger Rods: Threaded steel.

2.3 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 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1. NECA 1.
   2. NECA 101
   3. NECA 102.
   4. NECA 105.
   5. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for conduit as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. 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 single-bolt conduit clamps using spring friction action for retention in support channel.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) 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, conduit may be supported by openings through structure members, according to 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 (90 kg).

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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps.
7. To Light Steel: Sheet metal screws.
8. 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.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "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.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:
1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 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.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:
1. 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.
2. GRC: Comply with ANSI C80.1 and UL 6.
3. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   a. Comply with NEMA RN 1.
   b. Coating Thickness: 0.040 inch (1 mm), minimum.
4. EMT: Comply with ANSI C80.3 and UL 797.
5. FMC: Comply with UL 1; zinc-coated steel.
6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.
   1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Fittings, General: Listed and labeled for type of conduit, location, and use.
   3. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
   4. Fittings for EMT:
      a. Material: Steel.
      b. Type: Compression.
   5. 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.
   6. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

C. Joint Compound for GRC: 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 AND FITTINGS

A. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   1. ENT: Comply with NEMA TC 13 and UL 1653.

B. Nonmetallic Fittings:
   1. Fittings, General: Listed and labeled for type of conduit, location, and use.
   2. Fittings for ENT: Comply with NEMA TC 3; match to conduit or tubing type and material.
   3. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R 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.

B. 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.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy Type FD, with gasketed cover.

D. Metal Floor Boxes:
1. Material: Cast 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.
5. Refer to drawings for fittings and accessories.

E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

I. Gangable boxes are allowed.

J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

K. Cabinets:
1. NEMA 250, Type 3R 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.

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. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC.".
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC
   2. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
   3. Connection to Vibrating Equipment (Including Transformers and or Motor-Driven Equipment): LFMC.
   4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.
   1. Exposed: GRC.
   2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   4. Damp or Wet Locations: GRC.
   5. Boxes and Enclosures: NEMA 250, Type 1.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. 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. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
   4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter.

C. Do not fasten conduits onto the bottom side of a metal deck roof.

D. Keep raceways at least 6 inches (150 mm) away from parallel runs of hot-water pipes. Install horizontal raceway runs above water and steam piping.

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 (300 mm) of changes in direction.

G. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

H. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

I. Support conduit within 12 inches (300 mm) of enclosures to which attached.

J. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) 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 (3-m) 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 (50 mm) of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

K. Stub-ups to Above Recessed Ceilings:
   1. Use EMT for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

L. 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.

M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

O. 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 (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Q. Surface Raceways, where indicated on drawings:
1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) 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.

R. 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.

S. 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 an underground service raceway enters a building or structure.
2. Conduit extending from interior to exterior of building.
3. Conduit extending into pressurized duct and equipment.
4. Where otherwise required by NFPA 70.

T. Expansion-Joint Fittings:
1. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Exposed to Direct Sunlight, such as roofs: 155 deg F (86 deg C) temperature change.
   b. Attics: 135 deg F (75 deg C) temperature change.
2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F (0.06 mm per meter of length of straight run per degree C) of temperature change for PVC conduits.
3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches (915 mm) 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.

V. 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.

W. 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 the box and cover plate or the supported equipment and box.

X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. In sound-insulated or fire-rated walls, provide 24” separation.

Y. Locate boxes so that cover or plate will not span different building finishes.

Z. 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.

AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

BB. Set metal floor boxes level and 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 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
   2. Install backfill as specified in Section 312000 "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 (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
   4. Install manufactured rigid steel conduit elbows for stub-ups at 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 (75 mm) of concrete for a minimum of 12 inches (300 mm) 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 (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
   5. Underground Warning Tape: Comply with requirements in Section 260553 "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 (12.5-mm) sieve to No. 4 (4.75-mm) 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 (25 mm) above finished grade.

D. 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 260544 "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 078413 "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.
   2. Sleeve seal systems.
   3. Grout.
   4. Pourable sealants.
   5. Foam sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product; include VOC content for sealants.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:
   1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Pipe Sleeves, PVC:
   1. Description: ASTM D1785, Schedule 40.

C. Sheet Metal Sleeves, Galvanized Steel, Round:
   1. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch (0.6-mm); round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:
   1. Description:
      a. Material: Galvanized sheet steel.
      b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness must be 0.052 inch (1.3 mm).
2) For sleeve cross-section rectangle perimeter not less than 50 inches (1270 mm) or with one or more sides larger than 16 inches (400 mm), thickness must be 0.138 inch (3.5 mm).

2.3 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
   1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Stainless steel.
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
   1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.5 POURABLE SEALANTS

A. Description: Single-component, 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.

2.6 FOAM SEALANTS

A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. 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 079200 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless sleeve seal system 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.

C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

F. Underground, Exterior-Wall and Floor Penetrations:
1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
2. Install steel pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

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.

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. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME 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. Comply with NFPA 70E requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Match color-coding in existing building for ungrounded feeder and branch-circuit conductors.
   1. Color for Neutral: White.
   2. Color for Equipment Grounds: Green.

C. Warning Label Colors:
   1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

E. Equipment Identification Labels:
   1. White letters on a black field for “normal” power system.
   2. Black letters on a red field for “emergency” or “standby” power systems.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
   1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
   2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
   3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
   1. Minimum Nominal Size:
      a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
      b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
      c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameter and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and is 12 inches (300 mm) wide. Stop stripes at legends.

D. Underground-Line Warning Tape:
   1. Tape:
      a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
      b. Printing on tape shall be permanent and shall not be damaged by burial operations.
      c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
   2. Color and Printing:
      a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
      b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
      c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE"

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.6 TAGS

A. Write-on Tags:
1. Polyester Tags: 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:
a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
c. Engraved legend with white letters on a black background for “normal” power and black letters on red background for “emergency” or “standby” power.
d. Self-adhesive.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings,

manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

I. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

L. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

M. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."

N. Vinyl Wraparound Labels:
   1. Secure tight to surface at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

O. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

Q. Self-Adhesive Labels:
   1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

R. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

S. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

T. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

U. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

V. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

W. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.
   2. Install underground-line warning tape for direct-buried raceways.

X. Write-on Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using plenum-rated cable ties.

Y. Laminated Acrylic or Melamine Plastic Signs:
   1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

Z. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than **120**V to Ground: Identify with self-adhesive raceway labels or vinyl tape applied in bands.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, and handholes, use self-adhesive wraparound labels to identify the phase.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: **Self-**adhesive equipment labels.
   1. Apply to exterior of door, cover, or other access.
   2. 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.

H. Arc Flash Warning Labeling: Self-adhesive labels.

I. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with black legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

J. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes short circuit and protective device coordination study encompassing portions of electrical distribution system from normal power source or sources up to and including breakers in distribution panels and main breaker in each panelboard.

B. Related Sections:
1. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
2. Section 262416 - Panelboards.
3. Section 262813 - Fuses.
4. Section 262816 - Enclosed Switches and Circuit Breakers.
5. Section 263213 – Gaseous Engine Generators.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).

B. National Fire Protection Association:
1. NFPA 70 - National Electrical Code.

1.3 DESIGN REQUIREMENTS

A. Complete Short Circuit and Protective Device Coordination Study to meet requirements of NFPA 70.

B. Report Preparation:
1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.
2. Perform study with aid of computer software program.
3. Obtain actual settings for motor characteristics and equipment incorporated into Work.
4. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:
    a. Utility supply bus.
    b. Automatic transfer switch.
    c. Engine generator.
    d. Distribution panelboards.
    e. Branch circuit panelboards.
    f. Each other significant equipment location throughout system.

C. Report Contents:
   1. Include the following:
      a. Calculation methods and assumptions.
      b. Base per unit value selected.
      c. One-line diagram.
      d. Source impedance data including power company system available power and characteristics.
      e. Typical calculations.
         1) Fault impedance.
         2) X to R ratios.
         3) Asymmetry factors.
         4) Motor fault contribution.
         5) Short circuit kVA.
         6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
         7) Tabulations of calculation quantities and results.
      f. One-line diagram revised by adding actual instantaneous short circuits available.
      g. State conclusions and recommendations.
   2. Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.
   3. Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.
   4. Prepare detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
   5. Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following:
      a. Power company relay characteristics.
      b. Power company fuse characteristics.
      c. Low voltage equipment circuit breaker trip device characteristics.
      d. Low voltage equipment fuse characteristics.
      e. Cable damage point characteristics.
      f. Pertinent transformer characteristics including:
         1) Transformer full load current.
         2) Transformer magnetizing inrush.
         3) ANSI transformer withstand parameters.
         4) Significant symmetrical fault current.
      g. Pertinent motor characteristics.
      h. Other system load protective device characteristics.
         1) Phase and ground coordination of generator protective devices.
         2) Decrement curve and damage curve.
         3) Operating characteristic of protective devices.
         4) Actual impedance value.
         5) Time constants.
         6) Current boost data.
         7) Do not use typical values for generator.
      i. Transfer switch characteristics.
      j. Other system load protective device characteristics.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Qualifications Data: Submit the following for review prior to starting study.
   1. Submit qualifications and background of firm.
   2. Submit qualifications of individual or individuals performing the study.

C. Software: Submit for review information on software proposed to be used in performing study.

D. Product Data: Submit the following:
   1. Report: Summarize results of study in report format including the following:
      a. Descriptions, purpose, basis, and scope of study.
      b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
      c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
      d. Fault current calculations including definition of terms and guide for interpretation of computer printout.

E. Submit copies of final report signed by a professional engineer. Make additions or changes required by review comments.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Texas Dept. of Transportation Design standard.

B. Maintain one copy of each document on site.

C. Use commercially available software, designed specifically for short circuit and protective device coordination studies with minimum of three years documented availability approved by Architect/Engineer.

D. Perform study in accordance with IEEE 242.

1.6 QUALIFICATIONS

A. Study Preparer: Company specializing in performing work of this section with minimum three years documented experience and having completed projects of similar size and complexity within the past two years.

B. Perform study under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Texas with minimum of five years of experience in power system analysis.

C. Demonstrate company performing study has capability and experience to provide assistance during system start up.

1.7 PRE-INSTALLATION MEETINGS

A. Section 013000 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 SEQUENCING

A. Section 011000 - Summary: Requirements for sequencing.

B. Complete study within four weeks after pre-installation meeting.

C. Allow 2 weeks for review of completed study by Architect/Engineer.

D. Submit short circuit and protective device coordination study to Architect/Engineer prior to receiving final approval of distribution equipment shop drawings and prior to releasing equipment for manufacturing.

E. When formal completion of study will cause delay in equipment manufacturing, obtain approval from Architect/Engineer for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

1.9 SCHEDULING

A. Section 013216 - Construction Progress Schedule: Requirements for scheduling.

B. Schedule work to expedite collection of data to ensure completion of study for final approval of distribution equipment shop drawings prior to release of equipment for manufacturing.

1.10 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate work with local power company.

PART 2 - PRODUCTS

2.1 Not used.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Section 017000 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Provide assistance to electrical distribution system equipment manufacturer during start up of electrical system and equipment.

C. Select each primary protective device for delta-wye connected transformer so device's characteristic or operating band is within transformer characteristics, including point equal to 58 percent of ANSI withstand point to provide secondary line-to-ground fault protection.

D. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.

3.2 ADJUSTING

A. Section 017000 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Perform field adjustments of protective devices and modifications to equipment to place equipment in final operating condition. Adjust settings in accordance with approved short circuit and protective device coordination study.

END OF SECTION

SECTION 26 05 83
ARC-FLASH AND SHOCK HAZARD STUDY

PART 1 - GENERAL

1.1 This specification to be used when the category method parameters as defined by NFPA-70E - Standard for Electrical Safety in the Workplace cannot be met for PPE (Personal Protective Equipment) and so the incident energy method is used as defined by NFPA-70E.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.

B. National Fire Protection Association:
   1. NFPA 70E – Standard for Electrical Safety in the Workplace.

1.4 SUMMARY

A. Section includes a computer-based, protective device coordination study, equipment adequacy report and an arc-flash and shock hazard study to determine the arc-flash hazard distance and the incident energy along with voltage to which personnel could be exposed during work on or near electrical equipment. Contractor shall provide adhesive arc-flash labels on all equipment that describes the arc-flash and shock hazard level, approach distances, and required PPE.

1.5 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. 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.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.6 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form.
   1. Submit time current curves (TCC) showing protective device coordination signed and sealed by a Texas professional electrical engineer.
   2. Arc-flash study input data, including completed computer program input data sheets.
   3. Arc-flash study report; signed, dated, and sealed by a qualified professional electrical engineer registered in the state of Texas.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Software Developer.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

C. Section 017000 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

1.9 QUALITY ASSURANCE

A. Perform Work in accordance with Texas Dept. of Transportation Design standard.

B. Maintain one copy of each document on site.

C. Studies shall use computer programs that are distributed nationally, commercially available and are in wide use. Software to be designed specifically for arc-flash studies with a minimum of three years of documented availability. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable. Studies shall be sealed and signed by a Texas registered professional engineer.

D. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

E. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, 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.

F. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, available software developers offering software that shall be used for the Work shall be, the following:
   1. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and “desirable” features as listed in IEEE 399.

2.2 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash shock hazard analysis.
   1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
   2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
   3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of

the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

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. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
5. 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.
6. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
7. Motor horsepower and NEMA MG 1 code letter designation.
8. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

2.3 SHORT-CIRCUIT STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Short-Circuit Study Output:
   1. 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 and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

E. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude.
   2. Protective device clearing time.

3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Recommendations for arc-flash energy reduction.

F. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

G. Owner to receive indexed electronic copy of report in PDF format and SKM data base files using V7.0 of System Software.

H. Time current curves (TCC) in protective device study shall be color coded curves where the same color is used for one device if it is appearing on multiple TCC curves. Include partial I-line showing devices that are being coordinated on the TCC curve. Include transformer damage curve and cable damage curve.

2.4 ARC-FLASH AND SHOCK HAZARD LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. For calculated incident energy less than 40 calories per square centimeter, the label shall have an orange header with the wording, "WARNING, ARC-FLASH AND SHOCK HAZARD PRESENT, APPROPRIATE PPE REQUIRED" and shall include the following information taken directly from the arc-flash hazard analysis:
1. TxDOT equipment asset number
2. Bus Name: Equipment name/identification
3. Protection: Next upstream protection device ID
4. Nominal System Voltage.
5. Flash Protection Boundary
6. Incident energy
7. Working distance
8. Glove Class
9. Limited Approach Boundary
10. Restricted Approach Boundary
11. PPE required for the incident energy calculated
12. Engineering report number, revision number, and issue date.

C. For calculated incident energy equal to or greater than 40 calories per square centimeter, the label shall have a red header with the wording, "DANGER, ARC-FLASH AND SHOCK HAZARD PRESENT, DO NOT WORK ENERGIZED" and shall include the following information taken directly from the arc-flash hazard analysis:
1. TxDOT equipment asset number
2. Bus Name: Equipment name/identification
3. Protection: Next upstream protection device ID
4. Nominal System Voltage.

5. Flash Protection Boundary
6. Incident energy
7. Working distance
8. Limited Approach Boundary
9. Restricted Approach Boundary
10. Engineering report number, revision number, and issue date.

D. Labels shall be machine printed, with no field-applied markings.

E. Provide electronic replacement stickers and replacement stickers from the manufacturer for the applicable equipment.

F. Install the arc-fault shock hazard labels under the direct supervision and control of the Arc-Flash Study Specialist.

END OF SECTION

SECTION 26 09 13

ELECTRICAL POWER MONITORING AND CONTROL

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. Furnish and install, connect, program Blue Pillar generator monitoring system for the new generator installation project. It shall include managed monitoring services and any cellular data fees for one year after commissioning.

B. Section includes the following for monitoring and control of electrical power system:
   1. Software platform that collects data from disparate energy resources by layering appropriate integration hardware on top of existing or new assets. Provide interoperability using minimal form factor; and utilize multiple communication protocols in providing monitoring and control functionality.
   2. All submittals and associated materials, system/site/project documentation, and full system description provided via web/browser based interface, unless specifically requested otherwise.
   3. Virtual server instance and software.
   4. Communication network and interface modules for Modbus data transmission protocols.
   5. Digital/Analog I/O from Supported End Devices

C. Related Sections:
   1. Section 260553 “Identification for Electrical Systems”
   2. Section 263113 “Natural Gas Engine Generators”
   3. Section 263633 “Automatic Transfer Switch”

1.3 DEFINITIONS

A. ATS: Automatic Transfer Switch

B. CTs: Current Transformers

C. CSV: Comma Separated Values

D. EIA: Electronic Industries Alliance

E. EPSS: Emergency Power Supply System

F. Ethernet: Local area network based on IEEE 802.3 standards.

G. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.

H. HTML: Hypertext markup language.

I. I/O: Input/output.

J. JCAHO: Joint Commission on Accreditation of Healthcare Organizations

K. kW: kilowatt

L. KY Pulse: A term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay changing status in response to the rotation of the disk in the meter.

M. LCD: Liquid crystal display.

N. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.

O. Modbus TCP/IP: An open protocol for exchange of process data.

P. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

Q. PC: Personal computer; sometimes plural as “PCs.”

R. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

S. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.

T. RS-485: A TIA standard for multipoint communications using [one], [two] twisted-pairs.

U. SMTP: Simple Mail Transfer Protocol

V. TCP/IP: Transport control protocol/Internet protocol.

W. THD: Total harmonic distortion.

X. UPS: Uninterruptible power supply; used both in singular and plural context.

Y. WAN: Wide area network.

Z. OPC: Interoperability Standard for Industrial Automation and Related Domains

AA. OPC UA: OPC Unified Architecture

1.4 ACTION SUBMITTALS

A. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.

B. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Other Informational Submittals:
   1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. Include the following:
   1. Operating and applications software documentation.
   2. Software licenses.
   3. Software service agreement.

B. Software and Firmware Operational Documentation:
   1. Setting Owner's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.
   2. Software licenses and upgrades required by and installed for operating and programming digital and analog devices.

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.

1.8 COORDINATION

A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.
   1. Match components and interconnections for optimum performance of specified functions.

B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1. Automatic Transfer Switches Required Information: Type of Device, Location of Device (Building, Floor, Room), Device Characteristics
2. Fuel System Required Information: Type of Device, Location of Device (Building, Floor, Room), Device Characteristics

1.9 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support perpetually.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades for life of product deployment. Upgrade shall include new or revised licenses for use of software.

1. Software updates available on a regular basis as approved by Customer and will be installed by Provider as specified in Software License Agreement. System to allow for addition of new or future assets to monitoring and control system with no modification to existing hardware.

PART 2 - PRODUCTS

2.1 INSTALLER AND HARDWQRE REQUIREMENT

A. Blue Pillar, Inc. Integrated Solution
1. Aurora Platform Server and Associated Software and Configuration
   a. Server is virtual and hosted by Blue Pillar
   b. Remote Connection to Blue Pillar Server
      (a) Blue Pillar to provide cellular communication module.
2. All required standard Blue Pillar hardware package
   a. Provide required I/O module or associated Modbus cards to allow for proper communication per requirements listed below.
   b. Consult with Blue Pillar regarding hardwire connections or radio modules for communication between devices.

B. ATS Requirement
1. ATS supplier needs to ensure all equipment are installed necessary to monitor the below ATS conditions. Each condition will be monitored in the form of an independent auxiliary contact that will be closed when each condition is true:
   a. ATS is connected to normal source position
   b. ATS is connected to Emergency/Standby Source position
   c. Normal Source Voltage
   d. Normal Source Current
   e. Emergency/Standby Source Voltage
   f. Emergency/Standby Source Current
2. ATS supplier needs to ensure each ATS has ability to receive a remote test signal which will initiate a load test. Remote test signal from Blue Pillar will be in the form of a dry contact closure locally at the ATS.
   a. Remote test (REMOTE_TEST)

3. ATS supplier needs to ensure each ATS has fused load side line voltage connections available via a terminal block within the ATS enclosure. Each phase as well as neutral (if present) needs to be available on terminal block. Or, ATS shall have voltage readings available over Modbus Protocol.
4. ATS supplier needs to ensure all equipment is installed with on board power metering. Metering of Emergency and Normal sides. Meter needs to have an available and configured communications port capable of either a Modbus RTU connection (RS-422 or RS-485) or an ethernet connection.
5. ATS Manufacturer Preferred Options:
   a. Russelectric
      (a) RPTCS or 2000+ Controller – RS485 comm port must be configured
      (b) CS1A/CS2A – Source availability monitoring contacts
      (c) CS1P/CS2P – Transfer switch position monitoring contacts
      (d) XC1 – Remote test contact
   b. Consult with Blue Pillar about compatibility outside of these models.
6. Tags calculated by Blue Pillar System
   a. TRANSFER_TIME
   b. TIME_TO_AVAILABLE
   c. TIME_TO_TRANSFER
   d. METER_COMMUNICATION_ALARM
7. Power Requirement at the site for ATS panel
   a. 2.0A
   b. 120-277V line-neutral
   c. 208-480V line-line
8. Physical Space / Installation
   a. Site Specific

C. Generator Requirement
   1. All required standard Blue Pillar hardware package
      a. Blue Pillar system requires each generator to have an on-board controller installed and configured that is capable of presenting engine status and power data. Generator also needs to have a spare and configured communications port capable of Modbus RTU connection (RS-422 or RS-485).
      b. Minimum requirements
         (a) Engine Running (ENGINE_RUNNING)
         (b) Engine Start (ENGINE_START)
         (c) Generator not in Auto (ENGINE_NOT_IN_AUTO)
         (d) Generator Summary Alarm (SUMMARY_ALARM)
         (e) Kilowatts instantaneous (KW)
         (f) Power factor (PF)
         (g) V line-line per phase (VAB, VBC, VCA)
         (h) V line-neutral per phase (VAN, VBN, VCN)
         (i) Current per phase (AMPSA, AMPSB, AMPSC)
         (j) Frequency (FREQ)
         (k) Battery voltage (BATTERY_VOLTS)
         (l) Engine Oil Pressure (OIL_PRESSURE)
         (m) Engine Coolant Temperature (WATER_TEMP)
         (n) Engine runtime hours (ENGINE_HOURS)
         (o) Engine Fault (COMMON_SHUTDOWN)
      c. Blue Pillar system requires each generator to have a retrofit I/O kit added and wired

in to customer terminal board. I/O panel shall be capable of sending/receiving required command, alarms, and controls.

(a) Minimum requirements
  (i) Generator engine hours
  (ii) Generator status – Engine running, engine stopped
  (iii) Battery charger voltage
  (iv) Generator status – Common Alarm

2. Blue Pillar system needs to be able to access 9-36Vdc generator battery power.
3. Generator Manufacturer Preferred Options:
   a. Caterpillar – Controller model EMCP 3.2/3.3/4.2/4.3
   b. Cummins
      (a) PCC 2100/3100/3200 will need FT-10 communication board as well as Modlon. Modlon will need to be programmed for 38400 Baud rate and Address 1.
      (b) PCC 2.X/3.X
   c. Basler – DGC2020
   d. Consult with Blue Pillar about compatibility outside of these models

2.2 FUNCTIONAL DESCRIPTION

A. Project Deployment Characteristics
   1. Blue Pillar uses a rapid and scalable proprietary deployment model that enables ease of communication during the project and system deployment and construction process between multiple parties/stakeholders, including Owners, Consulting Engineers, Construction Management, Building IT Staff, and Financial Staff.
   2. Utilize an automated process for CAD/SCADA Development for supported Asset Template and associated Engineering Deliverables and Documentation
   3. Support for all NFPA 110 Types and Classes of EPSS Systems

B. Event Management: Provide System for managing and visualizing the system level operation of a Digital Energy Network.
   1. Supported Event Management Event Types Include:
      a. Demand Reduction or co-generator control/remote start.
      b. Automated Compliance Test.
      c. Unloaded Generator Test.
      d. Outage/Emergency Event.
   2. Supported Live Event Management Views Include:
      a. Ability for User to Annotate Event History Items
      b. Calendar-based View of Event History and Event Details
      c. Event notification for Remote System Initiation
   3. Supported Event Management Interoperability with other Platforms/Devices:
      a. Supervisory Control Systems (Software Systems)
      b. Third Party Messaging support using Energy System Alerts
      c. Third Party Messaging Hooks via Cloud Connection Services

C. System: Report equipment status and power system control.

2.3 SYSTEM OVERVIEW

A. Monitoring and Control System: Include integration with virtual server with web browser client access with its operating system and application software, connected to data transmission network.

B. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

C. Microserver based architecture to aggregate all distributed field I/O acting as consolidated communication gateways.

2.4 SERVER REQUIREMENT

A. Operating System Software: Based on Windows server 2012 or greater supporting MS .NET Framework 4.5 and browser (Chrome or Internet Explorer 10 or above) enabled client architecture. Software shall have the following features:
   1. Multiuser and multitasking to allow independent activities and monitoring to occur simultaneously at different workstations.
   2. Capability for future additions of new physical devices within the indicated system size limits.
   3. Virtual Server Support

2.5 APPLICATIONS SOFTWARE

A. Basic Requirements:
   1. All access to system is fully compatible with and based on the approved operating systems.
   2. Supports industry standard database and backup technology.

B. Data Formats:
   1. Reports and graphics accessible within a browser environment.
   2. Interactive graphics.
   3. Option to send preprogrammed or operator designed e-mail reports.

C. Metered Data: Display metered values in real time.

D. Control of System Events available through Software Interface
   1. Demand Reduction or Co-Generator Event
      a. Operator or Remote Initiation via Cloud Services of Event
      b. Open-ended event timing requiring operator initiation of the end of the Event
      c. Open-ended reduction event initiation with explicit start and stop commands
      d. Specified duration for system managed stop of event
   2. Compliance Test Event
      a. Pre-test checklist items required by operator for initiation
      b. Post-test checklist items required by operator for event completion
      c. Rotation of initiating ATS for annual initiation requirement
   3. Allow for Initiation of Unloaded Generator Test Event
   4. Equipment control within a test and/or event
      a. Automatic control via system with timed intervals for initiation and return to normal status. Settings included for block size and interval between block initiations.

b. Manual control enabling operator to explicitly control the active and inactive controls as desired within the context of the test

E. Equipment Documentation: Database for recording of equipment ratings and characteristics; with capability for graphic display of this information.

F. Graphics: Interactive color-graphics platform fully compatible with industry standard web browsers including but not limited to Internet Explorer 9+, Google Chrome, and Safari.

1. Live Site Summary Map View with summary status 'pins' and additional detail via zoom down to building level detail

2. Provide full visualization of Power System operation via interactive One-Line Diagram:
   a. Live System One-line animation of electrical system status and distribution flow
   b. Live System One-line equipment data display via user configuration
   c. Live System One-line equipment status
   d. Live System One-line event status visualization
   e. Live System One-line zoom available to full system or down to device level detail

3. Provide Site, System, and Device/Entity Summary Views:
   a. Live Site Summary View with Site Name, Event Status, Equipment Status, Production kW and Utility kW for selected sites
   b. Live system summary with system name, event status, equipment status, production kW, and utility kW
   c. Live system summary 'Icon' view rollup similar to windows explorer tile view
   d. Live system detail includes system summary status, equipment values, equipment status, communication status
   e. Configurable Entity Level Detail View for User Customization

G. User-Defined Monitoring and Control Events: Display and record with date and time stamps.

H. Trending Reports: Display data acquired from different meters or devices, in historical format over user-defined time; unlimited as to interval, duration, or quantity of trends.

I. Alarms: Display and record alarm messages from discrete input and controls outputs, according to user programmable setpoints.
   1. 24x7 'Health and Readiness' monitoring and alarming for all network communication equipment
   2. 24x7 Equipment Status Monitoring; configurable based on device
   3. Remote notification of system detected alarms for detection, clear, and acknowledgement to any device enabled with SMTP style address.
   4. Formula based custom monitoring for analog inputs
   5. Configurable Fuel System Level Alarming

J. Reporting: User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
   1. Operational Reporting
      a. Sort and report by device name and by function.
      b. Report type of signal (alarm, supervisory, or trouble), description, date, and time of

occurrence.
c. Differentiate alarm signals from other indications.
d. When system is reset, report reset event with same information concerning device, location, date, and time.
e. On screen detailed reports of event sequencing steps and individual equipment load profile graphs
f. Capture of Total Generator Run Time

2. Inventory Reporting: Store and Report the following information on Supported Equipment Types automatically directly from Surveyed Information.
a. Location
b. Ratings
c. Basic Operational Data

K. Integration: Applications Software to maintain integration with Blue Pillar cloud services

1. Multi-Site/Server integration via Blue Pillar cloud services with both integration and visualization through single service bus
2. External data posting ie: interval metering via Blue Pillar cloud service
3. External command integration via Blue Pillar cloud services
4. External command integration operator review and respond (approve/reject load event, alarm notification)

2.6 COMMUNICATION COMPONENTS AND NETWORKS

A. Network Configuration: MTCDT-LVW2-210L-US Verizon Cellular Gateway.

2.7 INTERFACE PANELS

A. Separately mounted, permanently installed instrument for power monitoring and control, complying with UL508A.

B. In design, space requirements for new layer of automation hardware rules of thumb include:
1. One new panel (approximately 16.02”H 14.01”W 8.35”D) for every two Automatic Transfer Switches – Consult with Blue Pillar to confirm site specifics.
2. Architecture for Communications consists of Panels for End Devices that aggregate device level I/O, and then communicate over an industrial or process communication bus among a string of panels. This string of panels will contain one Microserver with a unique IP address and connection to existing customer network – Consult with Blue Pillar to confirm site specifics.
3. Device level I/O consists of approximately 10 control wires and one communication level pair of conductors for each end Device/Entity – Consult with Blue Pillar to confirm site specifics.

C. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability.
1. Indoor installation in nontemperature-controlled spaces that have environmental controls

to maintain ambient conditions of 0 to 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

2. Outdoor installation to maintain ambient conditions of -30 to 160 deg F (minus 34 to plus 71 deg C) dry bulb and 0 to 100 percent relative humidity, noncondensing.

D. RMS Real-Time Measurements:
   1. Current: Each phase, neutral, average of three phases, percent unbalance.
   2. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
   3. Power: Per phase and three-phase total.

E. Demand Current Calculations, per Phase, Three-Phase Average and Neutral:
   1. Demand Real Power Calculations, Three-Phase Total:
   2. Minimum and Maximum Values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:
   3. Current and Voltage Capture:
      a. CTs to be of Split-core type when hot tapping of conductors is needed for retrofit applications.

F. Accuracy:
   1. Complies with UL508 requirements.
      a. Power: Accurate to 1 percent of reading for 10-100% measured of rated current.
      b. Voltage and Current: Accurate to 1 percent of reading for 10-100% measured of rated current.
      c. Energy (kW*hr): Accurate to 1 percent of reading for 10-100% measured of rated current.
   2. For meters that are connected to physical devices (endpoints), meters to communicate via industrial communication network/protocol.

G. Outputs:
   1. Operated/Triggered by:
      a. Local (Manual) System Event Initiation to be Maintained
      b. Remote System Event Initiation via Cloud
      c. Remote System Event Initiation via Remote Customer Contact/Initiation Hardware
      d. User Interface for change of Event Initiation and Security / Approval for event initiation
      e. Automatic Remote System Event Initiation on user-initiated schedule
      f. User Abort Command for event initiation to also be available within the application/software interface.
   2. Output Relay Control:
      a. Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
      b. Normally open and normally closed output contacts, configured to operate automatically with supported physical device and their corresponding automation devices/controllers.

H. Data Logging:
   1. Store logged data, alarms, events, and waveforms in onboard nonvolatile memory and

automatically backup/push to database service at regular increments. In the event of loss of database connectivity, functionality will enable storing of data in local memory and will persist upon database connectivity/return.

2. Allow for custom data logging defined by groups containing the values to be logged and frequency of logging.
3. Data logging groups to be supported on a by-device basis or by groups of sources.
4. Approximate data logging rate to cloud/server to be ~1 update/sec during an active event.
5. Retrieval of archived data provided via user selection of attributes and timing. Data export in CSV format available.

6. Stored Data will be automatically truncated (if desired) after a specified retention period for custom data logging groups.
   a. Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
   b. Waveform Log: Store captured waveforms configured as "first-in first-out."
7. Default values for all logs shall be initially set at factory, with logging to begin on system power up and installation/validation.

I. Control Power: 24VDC.

J. Communications:
   1. Microserver shall be permanently connected to communicate and support all of the following systems and communication protocols:
      a. Modbus TCP via a 100 Base-T Ethernet
      b. RS-485 Modbus
      c. TCP/IP
      d. OPC
      e. OPC UA

2.8 LOW-VOLTAGE WIRING

A. Comply with Section 260523 "Control-Voltage Electrical Power Cables."

B. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
   1. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
   2. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
   3. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLING

A. Comply with NECA 1.

B. Install cables and wiring according to requirements in Section 271500 “Communications Horizontal Cabling.”

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

E. Install cables without damaging conductors, shield, or jacket.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 “Identification for Electrical Systems.”

B. Label each power monitoring and control module with a unique designation.

3.4 GROUNDING

A. Comply with IEEE 1100, “Recommended Practice for Powering and Grounding Electronic Equipment.”

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. Electrical Tests: Use caution when testing devices containing solid-state components.
   2. Continuity tests of circuits.
   3. Operational Tests: Set and operate controls at workstation and at monitored and

controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.

a. Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
b. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
c. Verify accuracy of graphic screens and icons.
d. Metering Test: Load feeders, measure loads on feeder conductor with an rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.
e. Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.

E. Power monitoring and control equipment will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.

H. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

I. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

J. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.6 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain systems. See Section 017900 “Demonstration and Training.”
1. Train Owner’s management and maintenance personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment. Provide a minimum of 12 hours’ training.
2. Training Aid: Use approved final versions of software and maintenance manuals as training aids.

3.7 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy and vacancy sensors.
4. Digital timer light switches.
5. High-bay occupancy and vacancy sensors.
6. Lighting contactors.

B. Related Requirements:
1. Section 262726 "Wiring Devices" for wall-box dimmers and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Show installation details for the following:
   a. Occupancy sensors.
   b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and firmware operational documentation.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
   1. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Provide products as manufactured by one of the following:
   1. Honeywell
   2. Intermatic
   3. Tork

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: SPST.
   3. Contact Rating: 20-A, 120-/240-V ac.
   4. Programs: channels as shown on drawings; each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
   5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
   6. Astronomic Time: Selected channels.
   7. Automatic daylight savings time changeover.
   8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Provide products as manufactured by one of the following:
   1. Cooper
   2. Intermatic
   3. Leviton
   4. Tork

B. Description: Solid state, with SPST dry contacts rated for 20A, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with LED lamps.
   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 (16.14 to 108 lux), 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.
6. Failure Mode: Luminaire stays ON.

2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Provide products as manufactured by one of the following:
1. Cooper
2. Intermatic
3. Leviton
4. Lithonia
5. WattStopper

B. General Requirements for Sensors:
1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors. Refer to drawings for specifics.
2. Dual technology.
3. Integrated power pack.
4. Hardwired connection to switch.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
   a. Occupancy Sensor: 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.
   b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A LED 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.
10. Mounting:
    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. Dual-Technology Type: Wall or 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- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted 48 inches (1200 mm) above finished floor.

2.4 DIGITAL TIMER LIGHT SWITCH

A. Provide products as manufactured by one of the following:
1. Cooper
2. Intermatic
3. Leviton

B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10 minute increments up to 60 minutes.
1. Rated 10 A at 120-V ac or 277-V ac for LED lights, and 1/4 horsepower at 120-V ac.
2. Voltage: Match the circuit voltage.
3. Color: White.
4. Faceplate: Color matched to switch.

2.5 LIGHTING CONTACTORS

A. Provide products as manufactured by one of the following:
1. Allen-Bradley
2. Eaton
3. Leviton
4. Square D

B. Description: Electrically operated and electrically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served.

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 devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.6 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 INSTALLATION

A. Comply with NECA 1.

B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

C. 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.

D. 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.

E. 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.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch (21-mm).

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's written instructions.

C. Size conductors in accordance with 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.

3.3 IDENTIFICATION

A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   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.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: Within 12 months from date of Substantial Completion, Contractor shall provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
   1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
   2. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 26 22 13

LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
   3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Comply with NFPA 70.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Transformers Rated 15 kVA and Larger:
   1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
   2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

E. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

F. Coils: Continuous windings without splices except for taps.
   1. Coil Material: Copper.
   2. Internal Coil Connections: Brazed or pressure type.
   3. Terminal Connections: Bolted.

G. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.2 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated.
   1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound using a vacuum-pressure impregnation process to seal out moisture and air.
   2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
   3. Wiring Compartment: Sized for conduit entry and wiring installation.

D. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

E. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

F. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

G. Wall Brackets: Manufacturer's standard brackets.

2.3 IDENTIFICATION

A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

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 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
   1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
   1. 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.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

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."

C. 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.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

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. Perform tests and inspections.

D. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
   1. Visual and Mechanical Inspection.
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, and grounding.
      c. Verify that resilient mounts are free and that any shipping brackets have been removed.
      d. Verify the unit is clean.
      e. Perform specific inspections and mechanical tests recommended by manufacturer.
      f. Verify that as-left tap connections are as specified.
      g. Verify the presence of surge arresters and that their ratings are as specified.
   2. Electrical Tests:
      a. Measure resistance at each winding, tap, and bolted connection.
      b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
      c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
      d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details.
   2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   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.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet (2000 m).

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
   1. Panelboard Warranty Period: 24 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON 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. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Flush or Surface-mounted, dead-front cabinets as shown on drawings.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   2. Height: 84 inches (2.13 m) maximum.
   3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
   4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

E. Incoming Mains Location: Convertible between top and bottom.

F. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

G. Conductor Connectors: Suitable for use with conductor material and sizes.
   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
   3. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
   4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker or lugs only, as shown on drawings.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers:
      a. Inverse time-current element for low-level overloads.
      b. Instantaneous magnetic trip element for short circuits.
      c. 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. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
   5. Subfeed Circuit Breakers: Vertically mounted.
   6. MCCB Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Breaker handle indicates tripped status.
      c. UL listed for reverse connection without restrictive line or load ratings.
      d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
      e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
      f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.4 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NECA 407.

C. Mount top of trim maximum 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box.

E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-EMT) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. 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.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

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 or TXDOT approved equivalent

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. Camloks shall be color coded according to system voltage:
   a. A phase – Black
   b. B phase – Red
   c. C phase – Blue
   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

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Industrial-grade receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. Toggle switches, 120/277 V, 20 A.
4. Wall-box dimmers.
5. Wall plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 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 use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Device Color:
1. Wiring Devices Connected to Normal Power System: White or as selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Electrical System: Red.

F. Wall Plate Color: For plastic covers, match device color.

G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 INDUSTRIAL-GRADE RECEPTACLES, 125 V, 20 A:

A. Duplex Receptacles, 125 V, 20 A:
1. Description: heavy-duty, two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.4 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:
1. Standards: Comply with UL 20 and FS W-S-896.

B. Three-Way Switches, 120/277 V, 20 A:
1. Comply with UL 20 and FS W-S-896.

2.5 DIMMERS

A. Wall-Box Dimmers:
1. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
2. Control: Continuously adjustable buttons (up or down); with single-pole or three-way switching.
3. Standards: Comply with UL 1472.
4. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.6 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. 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: Smooth, high-impact thermoplastic
3. Material for Unfinished or Damp Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

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. 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.
2. 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.
3. Install wiring devices after all wall preparation, including painting, is complete.

C. Device Installation:
1. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

D. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles **up**, and on horizontally mounted receptacles to the left.

E. 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.

F. 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.

G. 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.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-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.

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

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cartridge fuses rated 600 V ac and less for use in the following:
      a. Enclosed switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
   1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
   2. Type RK-5: 600-V, zero- to 600-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 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Construction Manager.

3.2 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 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers (MCCBs).
   4. Enclosures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. 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. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. 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.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:
   1. Single throw.
   2. Three pole.
   3. 600-V ac.
   4. 1200 A and smaller.
   5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate reuired fuses.
   6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.3 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."

D. MCCBs shall be equipped with a device for locking in the isolated position.

E. Lugs shall be suitable for 140 deg F (60 deg C) rated wire on 125-A circuit breakers and below.

F. Standards: Comply with UL 489 with interrupting capacity to comply with available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal 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.

H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

I. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

J. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

3. 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.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R).

C. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.

3.2 INSTALLATION

A. 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. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

B. 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.

C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

G. Set field-adjustable circuit-breaker trip ranges to values indicated on the Drawings.

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. 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. Perform tests and inspections.

D. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that the unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the two following methods:
         1) Use a low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
      h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
      i. Verify correct phase barrier installation.
      j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
   2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

E. Tests and Inspections for Molded Case Circuit Breakers:
1. Visual and Mechanical Inspection:
a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:
1) Use a low-resistance ohmmeter.
a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.
2. Electrical Tests:
a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.

e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.

g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.

h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

SECTION 26 31 13

NATURAL GAS ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies the furnishing and installation of a packaged electric generating plant for standby service.

1.2 REFERENCE STANDARDS

A. ANSI C50.10 - General Requirements for Synchronous Machines.

B. EN 61000-6 - Electromagnetic Compatibility.

C. EN 55011 - CISPR 11.

D. FCC Part 15 Subpart B.

E. ISO - Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets.

F. NEMA MG 1 - Motors and Generators.

G. NFPA 70 - National Electrical Code.

H. NFPA 110 - Standard for Emergency and Standby Power Systems.

I. UL 508 - Standard for Industrial Control Equipment.

J. UL 2200 - Stationary Engine Generator Assemblies.

1.3 SUBMITTALS

A. Submit manufacturer's data on generator, muffler, battery, battery charger, control panel, remote alarm annunciator panel and any accessory equipment showing ratings, construction features, and performance characteristics.

B. Submit shop drawings of packaged unit and any separately mounted accessory equipment such as batteries and charger and remote alarm annunciator panel.

C. Dimensional elevation and layout drawings of the generator set, enclosure and related accessories. Include weight of the packaged unit.

D. Engine mechanical data including heat rejection, exhaust gas flows, combustion air and

ventilation air flows and fuel consumption and full load and half load.

E. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.

F. Concrete pad recommendations, layout and stub-up locations of electrical and fuel systems.

G. Submit schematic and wiring diagrams of the electrical system showing all factory wiring and clearly indicating all wiring and connections to be made in the field. Include internal wiring diagrams of any packaged controllers. Indicate wattage and voltage of any electrical strip heaters. Also submit fully detailed interconnection drawings indicating each individual connection to any remote equipment, including a separate connection drawing to show point-to-point electrical wiring connections.

H. Submit factory and field test report on the actual packaged electric generating plant provided, indicating results for all tests described herein.

1.4 OPERATION AND MAINTENANCE DATA

A. Provide operation and maintenance data in accordance with Section 26 00 00. Include the following information at a minimum.
   1. Project record drawings clearly indicating operating features and including as-built shop drawings, outline drawings, and schematic and wiring diagrams.
   2. Instructions for erection, alinement including tolerances, and preparation for use.
   3. Complete description of safety equipment, safety procedures, and safety precautions.
   4. Starting, normal running, emergency, and shutdown procedures.
   5. Normal maintenance, inspection and lubrication procedures.
   6. Recommended spare parts list.

1.5 WARRANTY

A. 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.

1.6 SPARE PARTS

A. Provide the Owner with two each of the following spare parts. Deliver the parts to the owner in the factory cartons as a requirement of project closeout.
   1. Air intake filters.
   2. Lube oil filters.
   3. Fuel

4. Filters.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the requirements, provide generator sets of one of the following manufacturers:
   1. Cummins.
   2. Caterpillar.
   3. Or TXDOT approved equivalent.

2.2 DESCRIPTION

A. Provide a complete, packaged, natural gas engine-electric generating plant which is pre-wired, pre-piped, assembled and aligned on a single skid-type base. Make the packaged system of new, unused equipment of the manufacturer's latest design. Include all necessary instruments, devices, switches, and other appurtenances for proper operation of the unit. Supply steel safety guards around all external rotating parts. Provide a unit on which adjustments, repairs and normal maintenance are possible without the use of special tools. Provide an overall, weatherproof housing as further described in this section. The supplier will be responsible for the proper performance of the complete unit and support systems. Transition time from the instant of failure of the normal power source to the generator source shall not exceed 10 seconds.

2.3 ENGINE GENERATOR SET

A. The natural gas fired engine-generator set shall be rated not less than the rating/capacity shown on the drawings at 0.8 power factor on a continuous standby basis. The AC synchronous generator shall be rated 60 Hertz, 4 pole, revolving field, 1800 RPM for use with a 120Y/208V, 3 phase, 4 wire electrical system.

B. The engine-generator set manufacturer shall verify the unit's KW/KVA rating after derating for the range of temperatures expected and the ambient temperature and altitude of installation as specified herein.

C. The engine-generator set shall be capable of picking up a minimum of 100% nameplate kW and power factor, less applicable derating factors, in one step with the unit at operating temperature.

D. The engine-generator set shall have a motor starting or surge KVA capability of three times the rated KVA based upon a recovered sustained RMS voltage drop of no more than 10% of no load voltage with the specified load KVA at or near zero power factor. Maximum instantaneous voltage dip shall not exceed 30% at this load and power factor level.

E. The engine-generator set shall be mounted on a suitable structural steel base capable of maintaining proper alignment between components during shipment, installation, and operation. Unit shall include proper vibration isolators to minimize noise and building

vibration.

F. A torsional analysis shall be calculated by the manufacturer of the engine-generator set to verify freedom from torsional stresses within plus or minus 10% of rated speed, with results submitted to the Owner for approval as specified herein.

G. The Total Harmonic Distortion (THD_v) for the output voltage, from no load to full linear load, shall not exceed 5% and no single harmonic shall exceed 3%.

H. The Telephone Influence Factor (TIF) shall be less than 50 per NEMA MG 1.

2.4 ENGINE AND EQUIPMENT

A. The engine shall be stationary, liquid-cooled, natural gas fueled, naturally aspirated or turbocharged, 4-cycle design, single crankshaft, in-line or V-type. Engine shall be direct connected to an alternating current generator via a flexible disk coupling. Engine shall be certified by the engine manufacturer as capable of developing adequate brake horsepower operating on natural gas having a BTU content of 900 to 1000 BTU per cubic foot to the unit in a vapor state, at a potential delivery rate of (13,000 CFH) Cubic Feet per Hour (CFH), to drive a generator delivering the rated kW on a continuous standby basis for ambient conditions of 110EF and 1,200 feet above sea level elevation for the duration of utility source interruptions. Rating must be substantiated with manufacturer's published curves after deducting all engine and motor driven accessories.

B. The cylinder block shall be cast iron with replaceable wet liners, and have four valves per cylinder with ignition by center fire spark. Valves and valve seat inserts shall be high alloy faced, 15 or 20 degree angle, with chrome plated stems, designed specifically for propane gas engine operation. Positive action valve rotators shall be provided. All components of the valve system shall be replaceable. The crankshaft and the connecting rods shall be forged steel.

C. The engine shall be water cooled with a skid-mounted high ambient temperature closed loop radiator system, belt-driven pusher fan, coolant pump, thermostat temperature control, engine mounted inter-cooler system, and coolant corrosion resister filters with service valves. Radiator, fan, pump, and circulation system shall be sized to cool the engine at rated load in 110EF ambient temperature at 1,200 feet above sea level elevation. Engine shall be equipped with a 50% ethylene glycol solution in the engine water jacket and radiator. Engine shall be equipped with a liquid level control to indicate alarm on low coolant level.

D. The exhaust manifold shall be jacket coolant cooled and fitted with exhaust temperature thermocouples located in each exhaust port. An oil pressurized nozzle shall provide additional piston cooling. For turbo-charged engines, air-to-air aftercooling (intercooling with internally mounted heat exchanger in the intake manifold) shall be engine mounted at the factory.

E. The engine shall be carbureted with a low pressure fuel (1.5 - 5.0 psi) utilization system. The air intake system shall be balanced for even fuel distribution. A reserve flow design

shall provide for adequate fueling during load pick-up.

F. The engine shall have a breaker-less, low-tension ignition system with fully sealed module-type electronics. Precise low cranking speed firing shall come from a magneto-type power source. The ignition system must fire each cylinder independently, with timing built into an integral unit. High voltage spark plug wires shall be of the RFI suppressant type. Spark plug probes shall be Teflon insulated and impervious to oil, antifreeze, and water.

G. Frequency regulation shall be by an electronic isochronous type governor that will provide constant speed and speed adjustment. Frequency regulation shall be +/- 0.25% of rated frequency from no load to full load.

H. Starting shall be electric, operating on a 24 volt battery supply. Batteries shall be furnished by Vendor. The starter shall disengage automatically when the engine starts.

I. Lubrication shall include positive displacement, mechanical lubrication oil pumps, lubricating oil coolers, pre-lubrication oil pump, full flow lubricating oil filters and dipstick oil level indicators.

J. Include fuel filters with replaceable elements and replaceable dry element air cleaner.

K. Engine shall have a starting jacket water heating system sized as recommended by the manufacturer operating at 240 volts, single phase, 60 hertz power and with thermostat to control the temperature of the heater to 120^0F $\pm 10^0$F. Upon engine starting, an oil pressure switch shall shut off the heater. Heating system shall include servicing valves that allow the elements to be removed without draining the unit.

L. Provide the initial charge of lubricating oil. The lubricating oil drain valve will extend beyond the skid.

M. Provide sensing elements on engine to initiate alarms and engine shutdowns.

2.5 ALTERNATOR

A. The AC alternator shall be a synchronous generator, four pole, revolving field, drip proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with a flexible disc.

B. Stator shall incorporate form wound coils, two-thirds pitch, wrapped with multiple layers of taping material and inserted into the stator slots. The rotor shall have an amortisseur (damper) winding, with layer wound mechanically wedged construction. The rotor shall be dynamically balanced. Surge suppressers shall be connected in parallel with the field winding. Use of field discharge resistance shall not be acceptable. Systems using three-wire solid-state devices shall mount the unit in a stationary location.

C. The insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation. Actual temperature rise measured by the resistance method at full load of KW/KVA shall not exceed 105**E** C with a 40**E** C ambient.

D. The alternator characteristic shall be matched to the torque characteristics of the engine in such a manner that with full load connected to the generator terminals, the generator can utilize all the available engine power without exceeding it at all speeds up to and through synchronous speed.

E. The alternator bearing shall be electrically insulated from the generator end bell to block potentially damaging shaft currents caused by imprecise manufacturing tolerances or variations in electrical steel.

F. The alternator shall be equipped with heaters operating on 12O or 240 VAC to control moisture condensation. Power for heaters shall be automatically turned off when unit is running.

G. The AC output leads of the alternator shall be brought out to a 600A main molded case thermal-magnetic circuit breaker of suitable voltage and continuous and interrupting current rating. The circuit breaker shall be UL listed and accessible through removable plates on either side of a sheet metal output box.

H. A control unit shall be installed and shall include an alternator field excitation circuit breaker of suitable continuous duty and interrupting ratings; AC ammeter and 3 phase selector switch; AC voltmeter and selector switch for all phase-to-phase and phase-to-neutral voltages; frequency meter; voltage adjust rheostat with +/- 5% adjustment; automatic voltage regulator; and necessary wiring and interconnections in accordance with the wiring methods set forth elsewhere in these Specifications.

I. Excitation - Permanent Magnet Generator (PMG). The permanent magnet excitation system shall derive excitation current from a pilot exciter mounted on the rotor shaft. It shall enable the alternator to sustain 300% of rated current for ten seconds during a fault condition.

2.6 VOLTAGE REGULATION

A. The digital voltage regulator shall be microprocessor based with fully programmable operating and protection characteristics. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. It shall exhibit the following operational characteristics:

1. Alternator output voltage maintained within +/- 0.25% at steady state conditions.
2. Alternator output voltage maintained within +/- 0.25% of rated value for any load variation between no load and full load.
3. Alternator output voltage drift no more than +/-0.25% of rated value at constant temperature.
4. Alternator output voltage drift no more than +/- 0.5% of rated value within a 40 change over ambient temperature range of -40øC to 70øc.
5. Response time less than 20 milliseconds.
6. Voltage buildup with alternator output as low as 6 volts.
7. At full throttle engine starting, output voltage overshoot no more than 5% of its rated value, with respect to the volts/Hz curve. Meets ISO 8325-3 class G2

specifications.

8. Power dissipation 55 W at 15 amps; <100 ma at rest.
9. Telephone Influence Factor (TIF) of less than 50.
10. Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to MIL STD 461C Part 9 and VDE 875 level N.
11. Maintain stable voltage control with 20% total harmonic distortion.

B. The regulator shall include the following features:

1. Voltage level rheostat to provide alternator output voltage adjustment of -10% to +10% of nominal. This shall be in addition to a programmable output voltage level of -25% to +10% .
2. Automatic gain adjustment to provide output voltage compensation for changes in load or frequency.
3. Manual gain adjustment 0 - 5% to provide compensation for line losses between alternator output terminals and the load.
4. Reactive droop adjustment programmable to allow paralleling without interconnect wiring between alternators, with 5% minimum droop at full load and 0.8 PF.
5. It shall allow system parameter setup and monitoring, and provide fault alarm and shutdown information through a keyed LCD display. A PC-based user interface shall be available to allow viewing and modifying operating parameters in a windowed environment. The regulator shall be factory preset but field programmable for:
   (a) voltage output
   (b) voltage, minimum
   (c) voltage droop/crosscurrent adjustment
   (d) voltage gain (IR compensation)
   (e) voltage gain, internal
   (f) current, output
   (g) field current variation
   (h) sensing, single or three phase
   (i) dual voltage/frequency slopes
   (j) slope intersect (knee) frequency
   (k) underfrequency set point
   (l) over/under voltage trip
   (m) over/under voltage trip time
6. Voltage output
   (a) voltage, minimum
   (b) voltage droop/crosscurrent adjustment
   (c) voltage gain (IR compensation)
   (d) voltage gain, internal
   (e) current, output
   (f) field current variation
   (g) sensing, single or three phase
   (h) dual voltage/frequency slopes
   (i) slope intersect (knee) frequency
   (j) underfrequency set point
   (k) over/under voltage trip

(l) over/under voltage trip time

2.7 AUTOMATIC ENGINE-GENERATOR SET CONTROLS

A. Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation, adjustable cycle cranking, digital AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cooldown timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid. Provide the following meters with digital readouts:

1. Engine oil pressure
2. Coolant temperature
3. Engine RPM
4. System DC Volts
5. Engine running hours
6. Exhaust pyrometer (thermocouples in individual exhaust ports)
7. Generator AC volts
8. Generator AC amps
9. Generator frequency
10. kW meter
11. Percentage of rated Power
12. kVA meter
13. kVAR meter
14. Power Factor meter
15. kWH meter

B. The control unit shall shutdown and lockout the engine upon any of the following events and/or conditions:

1. Overcrank. (See “cycle cranking function” description below.)
2. Overspeed.
3. Low lubricating oil pressure. A time delay relay shall be included to prevent alarms and premature shutdown of the engine before reaching operating speed.
4. High engine temperature.
5. Operation of remote manual stop.

C. The control unit shall include a cycle cranking function. The cranking cycle shall be non-adjustable and consist of an automatic crank period of approximately 15 seconds duration followed by a rest period of approximately 15 seconds duration. Cranking shall cease upon engine starting and running. An over-crank light, alarm bell and auxiliary contacts shall indicate when the engine fails to start due to malfunction. Failure to start after three cranking cycles (75 seconds) shall shutdown and lockout the engine. Shutdown control shall include an indicating light on the control panel. Control wiring shall be so designed so that this malfunction will lockout the automatic controls until the operator resets them after correction of the trouble.

D. Control panel mounted devices, status indicating lamps, and audible alarm with self-restoring silence shall be provided for the following:
   1. Standby generator operating.
   2. High engine jacket water temperature.
   3. Low jacket water temperature.
   4. Low lubricating oil pressure.
   5. Low main fuel supply.
   6. Control switch not in automatic position.
   7. Battery charger malfunction.
   8. Low coolant level.

E. Controls for automatically starting and stopping the engine shall be incorporated in the control unit. The control unit shall have automatic remote start capability. A panel mounted switch placed in the STOP position shall stop the engine, shall start and run the engine when placed in the RUN position, and allow the engine to start and run or stop from a remote contact's opening and closing when in the REMOTE position. A RESET switch shall be provided for resetting after emergency shutdown.

F. Starting and stopping the engine is to be sensed through an auxiliary contact located in the automatic load transfer switch, or through the manual start-stop.

G. If indicated on the drawings, provide a remote manual stop button with a key-switch lockout for engine emergency off.

H. Provide a lamp test switch for visual verification of operation.

I. All status indicating lights will be Light Emitting Diodes (LED's).

J. Remote Annunciator Panel: Surface mounted panel with brushed stainless-steel finish. Furnish alarm horn, and indicators and alarms as follows:
   1. Items listed in subparagraphs 1 through 7 below are required to meet NFPA 110.
      a. High battery voltage (alarm).
      b. Low battery voltage (alarm).
      c. System ready.
      d. Anticipatory-high water temperature.
      e. Anticipatory-low oil pressure.
      f. Low coolant temperature.
      g. Switch in off position (alarm).
      h. Over crank (alarm).
      i. Emergency stop (alarm).
      j. High water temperature (alarm).
      k. Overspeed (alarm).
      l. Low oil pressure (alarm).
      m. Line power available.
      n. Generator power available.
      o. Lamp test and horn silence switch.

2.8 UNIT MOUNTING

K. The engine-generator unit shall be mounted on a welded steel base suitable for skidding in place and bolting down.

L. Provide vibration isolators of the type and quantity recommended by the manufacturer and shall be sized for 2 inch static deflection.

2.9 FUEL SYSTEM

A. The fuel shall be natural gas with a minimum energy content of 905 British Thermal Units per cubic foot (905 Btu/Cu Ft LHV) or 33.72 Kilo-joules per liter (33.72 KJ/L) at ambient conditions of 30 inches of mercury and 60^0F. (LHV = Low Heat Value)

B. Provide typical accessories for the fuel supply system including regulators, strainer, flexible connecting hose, electric solenoid, etc., to provide a proper fuel supply to the engine.

C. The piping and gas cock shall meet the requirements as set forth for gas piping in Division 23.

D. The fuel regulator shall be selected and furnished by the generator manufacturer to provide proper fuel pressure and volume to the engine. The regulator shall be sized according to the on-site gas supply pressure of 1.0o - 5.0 per square inch. The generator manufacturer shall obtain the on-site gas supply parameters for proper selection of the gas pressure regulator. The exact routing and sizing of the natural gas piping shall be fully coordinated with the generator manufacturer to insure that the proper pressure and volume of gas is provide to the generator engine.

E. Fuel strainer shall be equal to OPW 387 with 40 mesh brass screen in a holding cage.

F. Fuel solenoid valve shall be 24 volt DC electric solenoid suitable to be open when engine runs and immediate shutdown on engine off or emergency.

2.10 ENGINE EXHAUST SYSTEM

A. OUTDOOR INSTALLATION

1. Exhaust piping shall be rigid exhaust pipe of size recommended by the engine supplier. All gasketing at flanges shall be non-asbestos type.
2. The exhaust silencer design shall be three chamber reactive type with body diameter $\geq$ 3 times the inlet diameter & body length > 10 times inlet diameter. Noise reduction equal to super critical hospital grade. Unit shall be provided with a condensate drain at bottom of the silencer body.
3. Exhaust outlet rain cap shall be a fully opening barometric type cap.
4. The exhaust connection from the engine exhaust manifold to the exhaust silencer shall be flexible stainless steel, not less than 18 inches long, furnished by the engine manufacturer.

2.11 RADIATOR DISCHARGE ELBOW

A. Provide an acoustically lined elbow to direct radiator fan discharge up. Make drain holes in bottom so rain water will not accumulate. Brace elbow structurally with steel that has been hot-dip galvanized after all cuts and holes have been made. Support system must be approved for strength, finish and appearance.

2.12 BATTERIES

A. Batteries shall be 12 volt heavy duty lead acid type.

B. Battery rack shall be as required for installation beside the engine and for battery terminals to be protected from accidental dropping of tools or similar devices.

C. Lugs and devices shall be included for proper interconnection of the battery components and control and starter connection cables.

D. Battery and cables shall be as sized and selected by the engine manufacturer.

2.13 BATTERY CHARGER

A. The charger shall be 100% solid state. DC output shall be voltage regulated and current limited so as not to require a cranking disconnect relay.

B. The charger shall include: full wave output, silicon semiconductors, automatic boost (equalize) mode, surge suppression, individual potentiometer adjustments for boost and float voltage, Solid-state Digital DC output voltmeter and ammeter, AC and DC fuses, input and output terminals, and DC output completely isolated from AC input.

C. The assembly shall have a 12O VAC input and shall be capable of restoring a pair of fully discharged batteries to a fully charged condition within 12 hours.

D. If designated by the Owner, the battery charger shall be located in the automatic transfer switch.

2.14 COMMUNICATIONS

A. 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

2.15 WEATHERPROOF HOUSING

A. Provide an overall weather-protective housing 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.

B. 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.

C. Cover all openings in the housing with 1/4-inch galvanized hardware cloth to keep out birds and small animals.

PART 3 - EXECUTION

3.1 STRUCTURAL FOUNDATION

A. Install packaged electric generating plant on new structurally engineered concrete pad.

3.2 INSTALLATION

A. Follow manufacturer's installation procedures. Have installation supervised and approved by a qualified representative of the unit manufacturer.

3.3 ENGINE EXHAUST

A. Install an 18-inch length of the specified exhaust tubing between engine exhaust outlet and muffler inlet. Turn muffler exhaust up and terminate with rain cap.

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 of 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 unit 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.

D 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.

E Instruments. Provide all instruments necessary to conduct the tests.

F 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.

G 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.

H 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.

I 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.

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

SECTION 26 36 33

AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install Automatic Transfer Switches (ATS) with bypass isolation and number of poles, amperage and voltage as shown on drawings, per facility electrical distribution. Withstand and Close-on ratings as listed in this specification are provided as a minimum requirement.

1.2 CODES and STANDARDS

A. The Automatic Transfer Switches and controls shall conform to the requirements of the following:
1. UL 1008: Underwriters Laboratories Standard for Transfer Switch Equipment
2. NFPA 70 National Electrical Code
3. NFPA 99 Essential Electrical Systems for Health Care Facilities
4. NFPA 110 Standard for emergency and standby power systems
5. ANSI/IEEE 446 Recommended Practice for Emergency and Standby Power Systems for Commercial Applications
6. NEMA ICS 10 P1 Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment
7. IBC-2006 International Building Code-Seismic Certified
8. UL 508 Standard for Industrial Control

1.3 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

2.1 ACCEPTABLE MANUFACTURERS

A. Provide automatic transfer switches as manufactured by Russelectric, type RTS03ABLB, or TxDOT approved equivalent.

2.2 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.
2. 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.
3. The transfer switch shall be mounted in a NEMA 3R 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.
4. 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.
5. 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/standby 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.
6. The automatic transfer switch shall be completely isolated from the bypass/isolation switch by means of insulating barriers and separate access doors.
7. 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.
8. The transfer switch shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.
9. The combination automatic transfer and bypass/isolation switch shall be top and bottom accessible.
10. The main contacts shall be capable of being replaced without removing the main power cables.
11. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.
12. All bolted bus connections shall have Belleville compression type washers.
13. When a solid neutral is required, a fully rated bus bar with required AL/CU neutral lugs shall be provided.
14. 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.
15. The complete combination automatic transfer bypass/isolation switch assembly shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.
16. 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/standby 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/standby 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

3.1 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.

3.2 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/standby, 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.

3.3 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/standby (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.

3.4 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

4.1 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.

4.2 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.

4.3 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.

4.4 TESTING

A. See generator specifications sub section “MANUFACTURER’S FIELD SERVICES” for testing requirements of automatic transfer switch.

END OF SECTION

SECTION 26 51 19

LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires as specified on the drawings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. 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.
   2. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Product Certificates: For each type of luminaire.

C. Product test reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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. 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 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.6 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 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).
   1. Relative Humidity: Zero to 95 percent.

B. Altitude: Sea level to 1000 feet (300 m).

2.2 LUMINAIRE REQUIREMENTS

A. Provide luminaires as specified and by manufacturers indicated on the drawings, or approved equivalents. Equivalents will be reviewed during the submittal process; there will be no “prior approvals.” Contractors are responsible for including costs in their bids to provide specified luminaires and all necessary accessories.

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. 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.

D. Recessed luminaires shall comply with NEMA LE 4.

E. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

F. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

2.3 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. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:
1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.4 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.

2.5 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "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 A641/A641M, 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.

PART 3 - EXECUTION

3.1 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 a vertical force of 400 percent of luminaire weight.

E. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.3 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 52 13

EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Emergency lighting.
   2. Exit signs.
   3. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting: A lighting fixture powered by emergency or standby generator.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of exit sign and lighting support, arranged by designation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, coordinated with each other, using input from installers of the items involved:

B. Product Certificates: For each type of luminaire.

C. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Provide luminaires as specified and by manufacturers indicated on the drawings, or approved equivalents. Equivalents will be reviewed during the submittal process; there will be no "prior approvals." Contractors are responsible for including costs in their bids to provide specified luminaires and all necessary accessories.

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. NRTL Compliance: Fabricate and label emergency lighting fixtures, exit signs, and batteries to comply with UL 924.

D. Comply with NFPA 70 and NFPA 101.

E. Comply with NEMA LE 4 for recessed luminaires.

F. Comply with UL 1598 for recessed luminaires.

2.2 EMERGENCY LIGHTING

A. Emergency Luminaires:
1. Emergency Luminaires: Fixtures as indicated on Drawings with no additional features than "normal" powered lighting fixtures except the source of power.

2.3 EXIT SIGNS

A. Internally Lighted Signs:
1. Operating at nominal voltage of 277 V ac.
2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.

2.4 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:
1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. 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. Clear, UV-stabilized acrylic.
   2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Conduit: Electrical metallic tubing, minimum 3/4 inch (21 mm) in diameter.

2.5 METAL FINISHES

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 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 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. Provide support for luminaire without causing deflection of ceiling or wall.

E. Wall-Mounted Luminaire Support:
   1. Attached to a minimum 20-gage backing plate attached to wall structural members
   2. Do not attach fixtures directly to gypsum board.

F. Suspended Luminaire Suppor.t:
   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
   2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.
   3. Continuous Rows of Luminaires: Use stem for wiring at one point and wire support for suspension for each unit length of fixture 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.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency lighting using approved fasteners in a minimum of four locations, spaced near corners of unit.

H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to emergency 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 19

LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
   2. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

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.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale and coordinated.

B. Product Certificates: For each type of the following:
   1. Luminaire.
   2. Photoelectric relay.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
   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.

1.6 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Provide luminaires as specified and by manufacturers indicated on the drawings, or approved equivalents. Equivalents will be reviewed during the submittal process; there will be no “prior approvals.” Contractors are responsible for including costs in their bids to provide specified luminaires and all necessary accessories.

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. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. UL Compliance: Comply with UL 1598 and listed for wet location.

F. Lamp base complying with ANSI C81.61.

G. CRI and CCT shall be as indicated on drawings.

H. Lamps dimmable from 100 percent to 0 percent of maximum light output.

I. Nominal Operating Voltage: 277 V ac.

J. In-line Fusing: Separate in-line fuse for each luminaire.

K. Lamp Rating: Lamp marked for outdoor use.

L. Source Limitations:
1. Obtain luminaires from single source from a single manufacturer.
2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Stainless steel. Form and support to prevent warping and sagging.

C. 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.

D. Diffusers and Globes:
1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. 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.

G. Housings:
1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

2.3 FINISHES

A. Variations in Finishes: 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.

B. 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.

C. 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, 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 or SSPC-SP 8.
   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 selected by Architect from manufacturer's full range.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Support luminaires without causing deflection of finished surface.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:
   1. Attached to a minimum 1/8 inch (3 mm) backing plate attached to wall structural members.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height as indicated on Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. 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.

K. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 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- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. 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. Verify operation of photoelectric controls.

C. Tests:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. 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.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

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 Presidio Maintenance Facility.

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. 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

B. 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

C. 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

D. 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 (one per MDF/IDF)
   a. Tripp lite Managed 16 Outlet (5-20R) Power Strip with Meter and NEMA 5-20P Input – Part Number PDUMH20NET
   b. Approved Equal

E. 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

F. Pathway Cable Support
    1. Panduit J-Mod Cable Support System
        a. Erico – CADDY CAT LINKS J-Hook Series
        b. Approved Equal

G. 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

H. 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

I. Fire Stop
1. STI Spec Seal
2. 3M Products

J. Plywood
1. 8’ H x 4’ W x ¾” Sheets of BC grade fire-rated plywood

K. Fire Retardant Paint (White)

L. Fiber Patch Cables
1. Leviton Fiber Optic patch Cords
2. Approved Equal

M. 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.

a. 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.

b. 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.

c. 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

d. 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.

e. 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 118 as indicated on the technology drawings

f. 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

g. 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 6 Cable
    g. Main Building Ground
    h. 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) New Presidio Maintenance Facility, located in Presidio, Texas ("Owner").

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, iStar Ultra control panels, power supplies, 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 9000 as a standard. This includes glass breaks, all position switches, duress/panic buttons cabling, etc., installation and programming to the C●CURE 9000 system.

D. The electronic surveillance system as specified is an industry standard and includes camera, encoders, 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, on site initial 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 OF TERMS AND ACRONYMS

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. TxDOT _ Texas Department of Transportation

I. PM – TxDOT Project Manager

J. SWH – 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.

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. The response will be disqualified if TxDOT is unable to verify qualification and experience requirements from the respondent's references. The response may be disqualified if TxDOT 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 SWH C●CURE® card access systems.
      b. Have successfully completed SWH certification course AC4005: C●CURE® 9000 Advanced Integrator and be certified by SWH as an Advanced Integrator.

   2. Install 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® 9000 System Installer/Maintainer with iSTAR™
            a) OR
         2) AC4004: C●CURE® 9000 System Installer/Maintainer and AC2414: iSTAR™
      b. A minimum of one Service Technician shall have successfully completed the following SWH certification course(s) and be certified by SWH as an Installer/Maintainer (Level 2):
         1) AC4004-1: C●CURE® 9000 System Installer/Maintainer with iSTAR™
            a) OR
         2) AC4004: C●CURE® 9000 System Installer/Maintainer and AC2414: iSTAR™

E. 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 initial programming matrix information for SWH C●CURE® card access system(s) and AD Cameras System.
6. Revise existing SWH 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 SWH 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 shall be provided and installed by Div. 26. The Contractor shall coordinate conduit and pathway requirements with Div. 26. 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. as maybe required based on site conditions). All access control communications shall be fully supervised OSDP.
10. Provide programming configuration spreadsheets to the TxDOT Security System Specialist for approval prior to programming.
11. Complete all system programming spreadsheets for TxDOT facilities associated to this solicitation. All programming shall follow the naming convention(s) outlined by TxDOT Statewide Security. TxDot Shall provide C●CURE configuration, programming, and naming convention guides to the Contractor 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.

F. Key Personnel Requirements: The Contractor's Project Manager shall:
1. Be on site during all phases of the project: Preparation, installation, and activation; until the SWH C●CURE® card access system and AD Camera System is complete and accepted by the Contractor's Project Manager.
2. Be available by phone 24 hours a day/7 days a week and shall respond to PM within 30 minutes of TxDOT's call and be onsite within 24 hrs.

3. Have the primary responsibility of the day-to-day operation, ensuring proper installation of the SWH C●CURE® card access system and coordination of all activities, situations, and issues with subcontractors and PM.
4. Be a permanent staff employee of the Contractor.

G. 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 the General Contractor.
3. Clean, repair, or replace any item damaged by the Contractor or subcontractor(s) during the installation to the satisfaction of General Contractor, at no additional cost.
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.

H. 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.

I. 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 Design Consultant.
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.
9. Manufacturer cybersecurity hardening guide. If one is not available, provide documentation from the manufacturer stating such.
10. A complete set of shop drawings to include but not limited to:
    a. Device locations
    b. Cable Type and Pathways
    c. Panel Termination Schedule
    d. Elevation drawings to illustrate the associated devices and the heights at which they will be installed.
    e. Proposed naming convention information.
    f. Signal Flow Diagram including full topology.
11. Supplemental documents to include but not limited to:
    a. Safety Plan
    b. Contractor QA/QC Document
    c. Contractor Cybersecurity Hardening Guide

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 Design Consultant 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 at no additional cost to the owner.

F. Contractor shall review all products specified and required for this project to determine if there are any lead times for any products that may cause any delay. Contractor shall clearly identify any concerns with lead times in writing to the Architect / Design Consultant / Owner. If the Contractor does not identify any concerns with products having long lead times, it will be understood there are no long lead time issues, and the Contractor will have all products on-site when needed to complete the job as per the project schedule.

G. 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.

H. All wiring, equipment, and installation materials shall be new and of the highest quality.

I. Labels on all wiring, materials, and equipment must indicate a nationally recognized testing laboratory.

J. 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. SWH C●CURE®
   2. Access Control Panels
      a. Software House iStar Ultra GCM (OSDP Version 2. or greater)
         1) USTAR-GCM
      b. Software House iStar Ultra ACM (OSDP Version 2. or greater)
         1) USTAR-ACM
      c. Input Boards – Enclosed Wall Mounted
         1) Software House I8
         2) AS0073-000
      d. C●CURE® iSTAR Edge
         1) GSTAR004-POE
   3. LifeSafety Power
      a. LifeSafety Power FPO150/250-2D82M8NL4E8S/T16-B (36H x 30W x 4.5D cabinet) prewired with network board and battery, 120vac
   4. Card Reader
         1) Wall Mount Card Reader - Wiegand off from the factory
            a) HID Signo 40 (Mobile-Ready Standard Profile Readers with 125kHz and 13.56MHz support – OSDP On, Wiegand Off) 40NKS-00-0002BR (No Substitutions)
         2) Mullion Mount Card Reader - Wiegand off from the factory
            a) HID Signo 20 Mobile-Ready Standard Profile Readers with 125kHz and 13.56MHz support – OSDP On, Wiegand Off 20NKS-00-0002BR (No Substitutions)
         3 Arming Station Arming Station Keypad Reader

a) HID Signo 40K Smartcard Arming Station Keypad Reader - Wall Switch Mount 40KNKS-00-00039Q (No Substitutions)

3) Long Range Card Reader – Wiegand (for vehicle gates only)
   a) HID MaxiProx 5375 plus long range with 24vdc power supply (locally)
4) Long Range Card Reader 24VDC power supply (board only)
   a) LifeSaftey Power FPO150
5) Wiegand Reader Extenders 12VDC power supply (board only)
   a) LifeSaftey Power FPO150
6) Power distribution Board
   a) LifeSaftey Power D8P
   b) Or TxDOT approved equal.
7) Wiegand Reader Extenders
   a) Cypress SPX-1300
   b) Or TxDOT approved equal.
8) 24x20x9 Vented Fiberglass Weatherproof NEMA Enclosure with Dual Cooling Fans and 120 VAC Outlets
   a) Altelix NFC242009VFA1
   b) Or TxDOT approved equal.
9) Stainless Steel Pole Mount / Flange Mount Kit
   a) Altelix NMKX-500-08
   b) Or TxDOT approved equal.
10) Adjustable Stainless Steel Mounting Bands for Pole Diameter up to 13 Inches
   a) Altelix HBS-12
   b) Or TxDOT approved equal.
11) 35mm Top Hat DIN Rail Kit
   a) Altelix DRS-NFC20
   b) Or TxDOT approved equal.
12) Trapped Key Interlock Type Lock Set with Key - (2) per enclosure
   a) Altelix HN-0001 (Surrender all keys over to GC/Owner)
   b) Or TxDOT approved equal.
13) Managed PoE Industrial Switch
   a) Comtrol RocketLinx ES7510-XT DIN Rail Mountable
   b) Or TxDOT approved equal.
14) PoE Industrial Switch Power Supply
   a) MeanWell SDR-240-48 Power Supply DIN Rail Mountable
   b) Or TxDOT approved equal.
15) 16/3 3-Foot Power Supply Replacement Cord, Heavy Duty, Weather Resistant Jacket, UL Listed
   a) Southwire 9703SW8808
   b) Or TxDOT approved equal.

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
   a. Provided by Owner (TxDOT). Refer to drawings details and location.
   b. Furnish and install dedicated power supply for pedestal card readers.
   c. Furnish and install, coordinate.
      Keying with local AHJ.

D. Electrified Locking Mechanisms will be provided and installed by DIV.8. The Contractor shall closely coordinate with DIV.8 Contractor, Architect and Design Consultant on the interface with electronic locking hardware. The Contractor will provide low voltage power to electronic locking hardware as well as control via the access control hardware via programing.

E. Request-to-Exit (REX) Device
1. REX Infrared Motion Sensor
   a. BOSCH DS160
   b. Or TxDOT approved equal

F. ADA Automatic Door Lock Interface
1. BEA – BR3-X
2. Or TxDOT equal

G. Duress/Panic Button
1. Honeywell 269R
2. Or TxDOT approved equal

H. Door/Gate Release Button
1. HUB3B Momentary
2. OR TxDOT approved equal

I. Video Display Monitor
1. American Dynamics Model ADLCD24MPB (24" LCD monitor)
2. Or TxDOT approved equal

J. Video Display Monitor Mount
1. American Dynamics ADWA1TR75100B
2. Or TxDOT approved equal

K. Gate Release
1. HUB3B Momentary
2. Or approved equal

L. Gate/Door Intercom
1. Viking Model E-30-IPEWP (if within distance limits) or Viking Model E-30-EWP
2. Viking VKW E5X5 back box for each Intercom
3. Viking Model # RC-4A or C 2000
4. Viking Model # E-35-IP/EWP (Door Only)

M. Gate Camera
1. IP: Illustra Model # IPSO2D2OSWIT
2. Or approved equal

N. Gate Camera power supply
1. AXIS T8123_E
2. Or approved equal

O. Video IP Decoder (as maybe required)
1. Costar CVI2MV2
2. Wisenet SPD-150 48CH Network Video Decoder
3. Or approved equal

P. Outdoor Rated Midspan POE (as maybe required)
1. Veracity VOR OUTREACH MAX universal Ethernet and POE extender
2. or approved equal.

Q. Glass Break Sensor
1. Ceiling Mount
   a. Honeywell FG730
   b. Or approved equal
2. Restrooms only
   a. Bosch ISC-SK10 Shock Sensor

R. Interior Speaker
1. Elk Products, ceiling mount speaker ELK-73
2. Or approved equal

S. Pre-Recorded Sounder
1. Elk Products, ELK-124
2. Or approved equal.

T. Exterior Weather Proof Strobe
1. Amseco, SL401 strobe light lens color blue
2. Or approved equal

U. Device Power Supplies (Glass Break Sensors, Pre-Recorded Sounders and Exterior Strobes)
1. LifeSafety FP075-D8PE2
2. LifeSafety Power FP075-2D8PE2
3. Or approved equal

V. Door/Vehicle Gate/Pedestrian Gate/ Roof Hatch Position Switches
1. Concealed Door/ Pedestrian Gate/ Roof Door Position Switch

a. GRI- 180-12WG
b. SECO-LARM SM-4105-LQ/W
c. Or approved equal

2. Surface Mount Door/ Pedestrian Gate/ Roof Door/Hatch Position Switch
   a. GRI 4400-A
   b. SECO-LARM SM-4601-LQ
   c. Or approved equal
3. Overhead Door Position Switch
   a. NASCOM N505AUTM/ST
   b. Bosch ISN-C66
   c. GRI 4110A-KIT
   d. SECO-LARM SM-4201-LQ
   e. Or approved equal

W. 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
   d. Or Approved Equal
2. Glass Breaks System Cabling
   a. West Penn
      1) 253241B- 22/4 Stranded overall aluminum shield plenum
   b. Windy 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 Water warrior 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

X. 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

Y. 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)

Z. Labeling
1. Permanent Printed Labels for Cables
Permanent Printed Labels for Cables

AA. Fire Stop
1. Shall match or exceed wall ratings
2. Shall be UL classified fire rated sealant
3. STI Spec Seal
4. 3M Products

BB. Network Cabling shall be provided, installed, and tested by Div. 27.

CC. Fiber Optic Equipment as maybe required will be provided and installed by Div. 27.

PART 3 - EXECUTION

3.1 CODES, STANDARDS, REGULATIONS

A. TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements – (May 2001)

B. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces - (October 2004)

C. TIA/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 Architect/ Design Consultant in writing of any such occurrences before purchasing or installing any equipment or materials. The Architect/ Design Consultant 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 Architect/ Design Consultant . The Contractor shall have written approval from the Architect/ Design Consultant for any additional work beyond the Contract Documents prior to beginning such work. If the Contractor does not obtain written approval from the Architect/ Design Consultant 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/ Design Consultant 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/ Design Consultant a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Architect/ Design Consultant 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 Architect/ Design Consultant .

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/ Design Consultant .

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 Architect/ Design Consultant to ensure that adequate conduit is provided and that equipment backboxes are adequate for system installation.
2. Coordinate with the Architect/ Design Consultant to ensure that adequate power has been provided and properly located for the security system equipment.
3. Coordinate with the Architect/ Design Consultant to ensure that doors and door frames are properly prepared for electric locking hardware and door position switches.
4. Coordinate locations of all devices with the Architect/ Design Consultant prior to installation.

5. Coordinate and verify the location of each piece of rack mounted equipment with the Owner.
6. Coordinate custom ACS report requirements with the Architect/ Design Consultant . Submit report formats to the Architect/ Design Consultant for review and acceptance.
7. Coordinate all initial database partitioning and setup with the Architect/ Design Consultant prior to initial programming and card holder data entry.
8. Coordinate final camera locations, desired views, and camera housing and mount requirements with the Architect/ Design Consultant prior to installation.
9. Coordinate camera housing and mount finishes with the Architect/ Design Consultant prior to installation.
10. Coordinate finishes and colors of all equipment with the Architect/ Design Consultant . Submit all finish and graphics for all equipment in public areas to the Architect/ Design Consultant for approval prior to installation.

B. General
1. Verify camera locations as shown on drawings.
2. Contractor or equipment manufacturer logos or names shall not be visible on equipment in public areas.
3. Provide tamper proof fasteners for all equipment in public areas. Fastener finish shall match equipment finish.

C. Access Control Software (ACS) Provided and programed by the owner.
1. 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. Video 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 network.
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. Wire / 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. 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.
10. Configure the control panel communication chains such that no more than 16 card readers (including all possible spare card readers) shall be connected to each control panel chain.
11. 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, details will be provided by TxDOT.

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 SIGNO 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. See part numbers noted above.
   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 will be provided and installed by DIV.8.

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 back-up battery chargers and batteries for all power supplies
5. Monitor low battery and power fail alarms for each power supply via.
6. Fire Alarm and fire alarm connection to the ACS shall be provided and installed by others.
   a. Connect (hard wire) fail-safe electric and time delay locking mechanical to the building fire alarm system for fail-safe release upon any fire alarm.
   b. Interface with a single low voltage/low current normally closed dry contact from the fire alarm system provided by the fire alarm contractor in the Fire Command Center (FCC). The contact shall open on any fire alarm condition.
   c. Provide all additional UL listed fail-safe relays and power supplies necessary to interface to this contact and unlock all fail-safe doors.
   d. Connect fail-safe relays and power supplies to standard building power. Connection of fail-safe devices to emergency or UPS power shall not be acceptable.
   e. Reference the drawings for fire alarm interface requirements.

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 (ADA automatic door opener shall be provided and installed by others (DIV.8).
   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.

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 Architect/ Design Consultant before installation.
2. This monitor will provide live viewing of the cameras selected by the District.
3. Monitor will be mounted at the front office area.

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 Architect/ Design Consultant. 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 new IP intercoms on gate pedestal as indicated on the plans. 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. The 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 Architect/ Design Consultant prior to installation.

5. Provide label on each glass break detector identifying programmed zone number per TxDOT 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 Architect/ Design Consultant 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 Architect/ Design Consultant 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 provided and installed by others. Network switches will be connected with Cat 6 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 any time.
    f. Vendor shall work with the Architect/ Design Consultant and the TxDot Security System Support Specialist for IP addressing.
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 the monitor and 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. See part numbers listed above.

W. Exterior Gate Network Cabling shall be provided and installed by others.
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 will be provided, installed, and tested by Div. 27.
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 Architect/ Design Consultant 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 will be provided, installed, and tested by Div. 27.
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 cable's 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 Architect/ Design Consultant and Security System Support Specialist

3.6 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.

3.7 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 (4) to (2) inches from the termination point inside the Equipment Room/Telecommunications/Security Control Location Rooms per TxDOT labeling scheme.

D. Cables shall be labeled within (4) 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

3.8 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.

3.9 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 Architect/ Design Consultant before installation.

3.10 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.

3.11 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 Architect/ Design Consultant.

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.

3.12 PANEL AND COMPONENT INSTALLATION

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.

3.13 CARD READERS

A. Vendor shall provide and install HID SIGNO 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.

3.14 CONDUIT, BOXES AND RACEWAYS provided and installed by Div. 26.

A. Install all conduits necessary for a complete installation, but not provided for in the electrical 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 Architect/ Design Consultant.

H. All conduit stub ups and panel conduit penetrations shall have plastic bushings installed at the ends.

3.15 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 230vac 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.

3.16 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 Architect/ Design Consultant

B. 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.

3.17 TRAINING

A. Coordinate with the Architect/ Design Consultant and 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 SWH C●CURE® card access system. This 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.

3.18 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.

3.19 SUBSTANTIAL COMPLETION

A. TxDOT Security Department must be notified and included.

B. To qualify for the Architect/ Design Consultant 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.

3.20 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 Architect/ Design Consultant and 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 its 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 final acceptance test by the Architect/ Design Consultant and 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 Architect/ Design Consultant or Owner.

M. Upon successful completion of the final acceptance test (or subsequent punch list retest), the Architect/ Design Consultant will issue a letter of final acceptance.

N. The Architect/ Design Consultant and/or TxDOT Project Manager retains the right to suspend and/or terminate testing at any time when the system fails to perform as specified. If it becomes necessary to suspend the test, all the Architect/ Design Consultant and 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 Architect/ Design Consultant 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 Architect/ Design Consultant Architect/ Design Consultant and the TxDOT PM must witness testing.

3.21 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 SECTION 28 13 00

SECTION 28 29 00

ELECTRIC GATE OPERATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electric gate operator(s), gate operator post, loop detectors, entrapment detector(s).

1.2 RELATED DOCUMENTS

A. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
   1. For completion of the Work of this Section, all documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
   2. Additional requirements in the documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.

B. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled “GENERAL NOTES” for the paragraph entitled "Related Documents" regarding supplementary information on the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.3 RELATED REQUIREMENTS

A. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
B. Division 26 sections: Requirements for electrical connections.
C. Section 32 31 13 - Chain Link Fence: Vehicle gates.

1.4 REFERENCE STANDARDS - Compliance with these standards is a requirement of the Work

A. ISO 9001 - Quality management systems -- Requirements 2015.
B. NEMA ICS 6 - Industrial Control and Systems: Enclosures 1993 (Reaffirmed 2016).
C. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.
D. UL 991 - Standard for Tests for Safety-Related Controls Employing Solid-State Devices October 22. 2004.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordination: Coordinate the installation of gate operators with size, location and installation of service utilities and operable gates.
B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Equipment list, system description, electrical wiring diagrams for installation, and manufacturer's data sheets on each product to be used, including:
   1.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, edge conditions, and accessories.
   1.
   2. Risers, layouts, and special wiring diagrams showing any changes to standard drawings.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 Certified Manufacturer.
B. Installer Qualifications: Installation performed by factory authorized contractor specifically trained in gate operation systems of the type found within this section.
   1. Provide documentation of maintenance and repair service availability for emergency conditions.
   2. Provide quarterly maintenance for one year following Substantial Completion of the Project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials and products in strict compliance with manufacturer's instructions and industry standards.
B. Store products indoors in manufacturer's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage.

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Provide two year manufacturer warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. LiftMaster: www.liftmaster.com..
B. Substitutions: Not permitted.

2.2 GATE OPERATORS

A. Gate Operators: LiftMaster SL595 Industrial Gear-Driven Slide Gate Operator.
   1. Compliance: UL Listed. Compliant to the UL 325, UL 991, and CSA C22.2 No. 247 standards.
      a. This model is intended for use in Class I, II, III and IV vehicular slide gate applications.
      b. To be UL 325 compliant, two independent safety entrapment protection devices must be installed at each entrapment zone (the inherent reversing system in this gate operator

counts as one device). Devices such as monitored photo eyes or edge sensors are required to be installed with this operator.

c. Only LiftMaster monitored photo eyes or edge sensors may be used with this operator to meet the UL 325 Standard.

2. Monitored Safety Inputs: 3 inputs per board (main board and expansion board) totaling 6 inputs with any combination of up to:
   a. Main Board:
      1) 1 Monitored Close Photo Eye input
      2) 1 Monitored Open Photo Eye input
      3) 1 Monitored Open Safety Edge or Open Photo Eye input
   b. Expansion Board
      1) 2 Monitored Safety Edge or Phot Eye inputs (selectable for Open or Close).
      2) 1 Monitored Photo Eye input (selectable for Open or Close).
      3) 8 Monitored edges available when Transceiver is added.
3. Warranty: 2 years.
4. Operator Speed: 12 inches (305 mm) per second.
5. Electrical Power Requirements:
   a. 115/208/230V AC, single phase, 60 Hz.
6. Accessory Electrical Power Requirements: 24V AC.
   a. Main Board: 12V AC, maximum 500mA.
   b. Terminal Strip:
      1) 2.2A maximum for 115/208-230V AC, single phase.
7. Gear Reduction: 20:1 wormgear reducer in synthetic oil bath.
8. Motor: Switchless1 HP, continuous duty
   a. Capacity: Supports gate lengths up to 70 feet (21.5 m) and gate weights up to 1,700 pounds(71 kg).
   b. Recommended Cycles per Hour: 25.
9. Metal Frame: 7 gauge pre-galvanized steel.
10. Chassis: Powder-coated galvanized steel.
11. Enclosure: NEMA 3R enclosure; oil-tight, weatherproof NEMA 3R cabinet, lockable. NEMA ICS 6.
12. Chain: #50 nickel-plated, 25 feet (7620 mm) supplied with each unit.
13. Gearbox: All-weather.
14. Internet Connectivity: MyQ Technology.
   a. 902 to 928 MHz
   b. 50-channel FHSS (Frequency Hopping Spread Spectrum).
   c. LiftMaster 828LM Internet Gateway enables monitoring and control of gate operators via internet-enabled smartphone, tablet or computer
   d. Provides two-way communication between gate operator and MyQ accessories to enable remote open, close and monitoring of gate.
15. Receiver:
   a. Security+ 2.0 3-channel on-board radio receiver, holds up to 50 remote controls (unlimited with use of 811LM/813LM), HomeLink compatible
   b. Transmits 310 MHz, 315MHz, 390 MHz

16. Inherent Reversing Sensor: Utilizes Current Sense and RPM Sensor to detect obstructions or increased loads. Reverses gate when closing or stops/reverses the gate when opening.
17. Lockout/Tag out: Prevents power from being switched on when servicing operator. Safeguards workers from high voltage power.
18. Wireless Dual-Gate Operation:
    a. Built-in wireless communication will operate primary and secondary operator without having to run a communication wire.
    b. Support for through-beam photo eye in the wireless dual-gate setup. Can attach emitter and receiver to each operator, eliminating the communication wire between them.
19. LED Diagnostic Display: Simplifies installation and troubleshooting.
20. Colored Terminal Blocks: Provides easy identification of safety and fire department inputs.
21. Programmable Auxiliary Relays: 2 programmable relays with 6 settings each.
    a. Pre-warning or gate-in motion sounder
    b. Switch on/off devices at open or Close Limits or while gate is in motion.
    c. Tamper detection if gate is pushed off Close Limit
    d. Cycle quantity feedback.
    e. Red/Green Light to control gate traffic.
22. Quick Close, Anti-Tailgate: Quickly secures property, preventing unauthorized access.
23. Sequenced Access Management: Capable of sequentially controlling the operator in tandem with a barrier gate.
24. Surge/Lightning Protection: Industrial Surge Protection on high and low voltage inputs. Protects against lightning strikes at a 50-foot (15.2m) radius.
25. Plug-in Loop Detector Inputs: Programmed inputs for shadow, interrupt and exit.
26. External Alarm Reset Button: Allows for quick reset of the gate operator when the alarm has been activated.
27. Warning Device: UL 325 compliant entrapment warning alarm has ability to be set for pre-operation warning; provides a 3-second warning prior to and during gate movement.
28. Maximum Run Timer: Protects against damage to the gate and operator by limiting the unit's runt time to 120 seconds.
29. Lockable External Manual Disconnect: Allows gate to be opened in the event of a power loss without removing the operator cover.
30. Mechanical Braking: the mechanical braking system adds substantial gate position control at all points in travel. The solenoid-actuated b rake system also prevents the gate from being back-driven
31. Friction Clutch: Adjustable friction clutch helps protect gate and operator from damage should the gate meet an obstruction.
32. Limit Settings: Driven limit nut switches are fully adjustable to provide precision, accuracy and reliability.
33. Operating Temperature Range:
    a. Without heater: -4 degrees F (-20 degrees C) to 140 degrees F (60 degrees C).
34. Accessories: Provide safety Monitoring Devices:
    a. Monitored Photo Eyes
        1) Omron E3K-R10K4-NR Reflective Photo Eyes on all gates
35. Accessories: Provide Vehicle loop detectors

a. Monitored Vehicle loop detectors
    1) EMX D-TEK PCB Detector (minimum 1 EA Entrance, 2 EA Exit)
36. Accessories: Provide Vehicle gate loop
    a. Minimum 14 AWG
    b. Direct Burial rated
    c. Exit/Entrance SLIDE GATES
        1) 1 EA Exit loop
        2) 2 EA Reversing loops

PART 3 EXECUTION

3.1 EXAMINATION AND

A. Inspect and prepare substrates using the methods recommended by the manufacturer for achieving best result for the substrates under project conditions.
B. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings.

3.3 SYSTEM STARTUP

A. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.
B. Test for proper operation and adjust until satisfactory results within manufacturer's published tolerances are obtained.

3.4 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 – GENERAL

1.1 DESCRIPTION

A. The work covered by this item consists of preparing the right-of-way for construction operations by removing and disposing of all obstructions from the right-of-way and from designated easements, where removal of such obstructions is not otherwise provided for in the plans and specifications.

B. Such obstructions shall be considered to include, but not limited to, remains of foundations, floor slabs, concrete, brick, lumber, plaster, abandoned utility pipes or conduits, underground equipment or other foundations, fences, retaining walls and all other debris, as well as buried concrete slabs, curbs, driveways, and sidewalks.

C. This item shall also include the removal of trees, stumps, bushes, shrubs, brush, roots, vegetation, logs, rubbish, paved parking areas, miscellaneous stone, brick, drainage structures, manholes, inlets, scrap iron and all debris whether above or below ground except live utility facilities.

D. It is the intent of this specification to provide for the removal and disposal of all obstructions to the new construction together with other objectionable materials not specifically provided for elsewhere by the plans and specifications.

E. Unless shown otherwise on the plans, all fences within the project area which are damaged, or removed temporarily by the Contractor shall be replaced by the Contractor to an equal or better condition.

PART 2 – EXECUTION

2.1 CONSTRUCTION METHODS

A. Areas designated on the plans shall be cleared of all obstructions, vegetation, abandoned structures, etc., as defined above, except trees or shrubs specifically designated in the drawings for preservation. Trees and shrubs designated for preservation shall be carefully trimmed as directed and shall be protected from scarring, barking, or other injuries during construction operations. Exposed ends of pruned limbs shall be treated with an approved asphaltic material.

B. During all demolition, the Contractor must proceed in a manner that will insure maximum safety of his employees and the general public.

C. Unless otherwise indicated on the plans, all underground obstructions shall be removed to the following depths:

D. In areas to receive embankment, two feet (2') below natural ground.

E. In areas to be excavated, two feet (2') below the lower elevation of the excavation.

F. All other areas, two feet (2') below natural ground.

G. Holes remaining after removal of all obstructions, objectionable materials, vegetation, etc. shall be backfilled and tamped with suitable material, and the entire area bladed to prevent ponding of water and to provide drainage. In areas that are to be immediately excavated, backfilling and blading may be eliminated. Areas to be used as borrow sites and material sources shall have all obstructions, objectionable materials, vegetation, etc., removed to the complete extent necessary to prevent such objectionable matter from becoming mixed with the material to be used in the construction.

H. Where a conduit is shown to be replaced, it shall be removed in its entirety and all connections to the existing line shall be extended to the new line. Where an existing conduit is to be cut and plugged, the line shall be cut back not less than two feet (2') and a plug of concrete not

less than two feet (2') long shall be poured and held in the end of the pipe, or the plug may be accomplished by using a precast stopper grouted into place.

I. Material to be removed will be designated on the plans. All "Salvageable" material will remain the property of the Owner and will be stored at the site as directed by the Owner. All "Non-Salvageable" materials and debris removed shall become the property of the Contractor and shall be removed from the site and shall be disposed of properly.

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 – GENERAL

1.1 PROVISIONS
- A. Requirements of the General Provisions apply to all work under this section.
- B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Those judged to be equal to that specified will receive written approval.

1.2 DESCRIPTION
- A. Work covered by this section includes furnishing of all materials, labor, services, equipment, other items, and appliances necessary for the execution, installation and completion of all work specified herein and/or shown on the drawings. This includes, but is not limited to pre-excavation, stockpiling and disposition of topsoil and subsoil, rough grading and contouring of site in preparation for building excavation, and compaction of soils.

1.3 RELATED WORK
- A. The following items of related work are specified and included in other sections of these specifications:
  1. Section 31 11 00 – Clearing and Grubbing
  2. Section 31 23 00 – Structural Excavation and Backfill

1.4 REFERENCE STANDARDS
- A. ASTM D698-Latest - Tests for Moisture-Density Relations of Soils and Soil Aggregate Mixtures using 5.5 lb. rammer and 12 inch drop.
- B. ASTM D1557-Latest - Tests for Moisture-Density Relations of Soils and Soil Aggregate Mixtures using 10 lb. rammer and 18 inch drop.

1.5 SUBMITTALS
- A. Project Record Documents:
  1. Maintain existing utilities and accurately record location of newly encountered utilities remaining, rerouted utilities, new utilities by horizontal dimensions, elevations or inverts, and slope gradients.
  2. The contractor must arrange for and pay for certification by a registered engineer that the grading has been completed per the approved plan.

PART 2 – PRODUCTS

2.1 MATERIALS
- A. Fill: Clean soils free of vegetation, debris and organic contaminates with:
  1. No fragment larger than 3 inches in size.
  2. 100 percent passing 3 inch sieve.
  3. 50 to 100 percent passing No. 4 sieve.
  4. 20 to 60 percent passing No. 200 sieve.
  5. No more than 1.5 percent expansion performed on samples remolded to 95 percent of maximum ASTM D698 density and 3 percent below optimum moisture submerged and confined under 100 psf surcharge pressure.
  6. Maximum plasticity index of 15 as determined in accordance with ASTM D4318.

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify construction staking and surveying.
B. Identify and maintain required lines, levels, contours, and Datum.
C. Identify, maintain and protect existing utilities remaining which pass through construction area.
D. Notify utility company to remove and relocate utilities when required for construction.
E. Upon discovery of unknown utility or concealed conditions, discontinue affected construction and notify Architect.

3.2 EXCAVATION

A. Excavate upper 6 inches of topsoil when dry from areas to be further excavated, relandscaped or regraded. Stockpile topsoil to be used.
B. Excavate to elevations and grades indicated.
C. Widen depressions to accommodate compaction equipment and level basis for placing fill.
D. Stockpile excavated material to be reused on site where directed, not deeper than 6 feet and with maximum 25 percent slope. Cover stockpiles to prevent erosion.
E. Grass, grass roots and incidental topsoil shall not be left beneath a fill area nor shall this material be used as fill material. It may be stockpiled for later use in the top 6 inches of fills outside building pads and roadways.
F. Remove unusable and surplus material from site.

3.3 SCARIFICATION

A. Scarify, moisture condition and compact exposed natural surface soils to minimum 12 inch depth in building, exterior slab and pavement areas. Bring the upper 12 inches to optimum moisture content or above as determined in ASTM D1557.
B. Scarify soils disturbed by agricultural tilling to depth of disturbance.
C. Scarify undisturbed surfaces to receive fill to depth of 6 inches.

3.4 FILL

A. Existing site soils shall be used for fill materials within building areas, beneath exterior concrete slab areas, beneath asphalt pavements and in landscaped areas, provided they meet the Materials requirements specified above and as required in the Geotechnical Report. Blend and provide imported soils as required.
B. Place fill in maximum 8 inch deep compacted lifts to obtain elevations and grades.
C. Deeper lifts may be authorized when proposed equipment is proven to compact deeper lifts.
D. Controlled fill shall not be constructed when the atmospheric temperature is below 35°F. When the temperature falls below 35°F, it shall be the responsibility of the contractor to protect all areas of completed surface against any detrimental effects of ground freezing by methods approved by the geotechnical engineer. Any areas that are damaged by freezing shall be reconditioned, reshaped, and compacted by the contractor in conformance with the requirements of this specification.

3.5 COMPACTION

A. Use mechanical compaction equipment which will not disturb adjacent structures. Do not use water settling and jetting methods.
B. Compact fill materials in accordance with ASTM D1557.
C. Rework, moisten or dry as required, and compact exposed surface and subgrade soils to minimum depth of 8 inches. Reworking may be accomplished by scarification, dicing, removal and replacement or other method which will result in uniform moisture contents and densities.
D. Compact soils within following ranges of moisture content:

1. On-Site Subgrade Soils: 2 percent below optimum or higher.
2. Imported Soils: 2 percent below optimum or higher.
3. Subgrade Soil and Fill Below Asphaltic Pavement: 2 percent below optimum or higher.

E. Compact fill materials to following minimum percent compaction:
   1. Native Soils and Subbase Fill:
      a. Below footings 95 percent
      b. Below slabs-on-grade 95 percent
      c. Below pavement 95 percent
   2. Subbase Fill:
      a. Below footings 95 percent
      b. Below slabs-on-grade 95 percent
      c. Below pavement 95 percent
   3. Base Course:
      a. Beneath concrete slabs 95 percent
      b. Beneath pavement 95 percent
   4. Miscellaneous Backfill outside of building pad (Not Intended for Lateral Support of Pipelines): 90 percent

3.6 SUBGRADE PREPARATION

A. Maintain subgrade of areas to be covered with structural fill or aggregate base course in moist condition until covered.

3.7 GRADING TOLERANCES

A. Subgrade at Building Pad Areas: Within 0.02 feet from grades and cross-section indicated.
B. Subgrade at Other Areas: Within 0.10 feet from grades and cross section indicated.
C. Variations Within Tolerances: Compensating so that average grade and cross-section are met.

3.8 OBSERVATION AND TESTING OF WORK

A. Observation and testing shall be performed by an independent geotechnical testing laboratory in accordance with governing agencies and regulations.
B. Testing shall be performed in a manner that does not interfere with construction activities.
C. When tests indicate that compacted materials do not meet specified requirements, correct defective construction, and have construction retested.
D. Ensure compacted fills are tested before proceeding with placement of surface materials.
E. Tests of fill materials and embankments will be made at the following suggested minimum rates:
   1. One field density test for each 500 square yards of original ground surface prior to placing fill or constructing floor slabs.
   2. One field density test for each 250 cubic yards of fill placed or each layer of fill for each work area, whichever is the greater number of tests.
   3. One moisture-density curve for each type of material used, as indicated by sieve analysis and plasticity index.
   4. The geotechnical engineer shall submit, daily, the results of field density tests required by these specifications. Reports shall be submitted to the Government's Contracting Officer.

3.9 PROTECTION

A. Protect trees, shrubs, and other features remaining as portion of final landscaping.
B. Protect bench marks, property monuments, walls, fences, roads, sidewalks paving and curbs.
C. Protect above or below grade utilities which are to remain.
D. Protect newly graded areas from traffic and erosion, keep areas free of trash and debris. Repair and reestablish grades in settled, rutted, or eroded areas.

E. Repair damage.

END OF SECTION

SECTION 31 23 00

STRUCTURAL EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 DESCRIPTION

This section describes the excavation and backfill for all structures except pipe sewers, the backfilling around completed structures, and the disposal of all excess excavated material. All operations required for the proper completion of the excavation work, including sheeting, shoring, bracing, dewatering of excavations, and compaction of backfill are included under this section.

1.2 REFERENCE STANDARDS

Perform all work in this section in accordance with applicable sections of the following standards, except as modified in this specification.

A. American Society of Testing and Materials (ASTM).
B. American Association of State Highway and Transportation Officials (AASHTO).

1.3 PAYMENT

No separate payment will be made. Include cost of work in other related bid prices.

1.4 PROTECTION

Before the start of earthwork operations, adequately protect existing structures, utilities, trees and shrubs and other permanent objects. Costs resulting from damage to permanent facilities due to negligence or lack of adequate protection will be charged to the Contractor. The Contractor will also be charged for damage to facilities scheduled for later removal or demolition if the damage sufficiently impairs proper operation to the extent that temporary replacement or repair is required.

PART 2 - PRODUCTS

2.1 REGULAR BACKFILL

Where no other backfill is specified, use suitable soils from the excavation as backfill material.

2.2 SAND BACKFILL

Where sand backfill is specified, use reasonably clean bank sand from an approved source. The sand must be free from large lumps of clay, rubbish, organic matter or other deleterious substance. Not more than 12 percent (12%) by weight shall pass the 200 mesh sieve and the plasticity index shall not exceed 4.0.

2.3 CEMENT-STABILIZED SAND BACKFILL

A. Prepare a mixture of sand, cement and water.
B. Use washed river sand free from large clay lumps or appreciable amounts of other foreign materials. The sand must not be darker than the standard color when subjected to a color test in accordance with ASTM C-40.
C. Required gradation of sand:

Screen Size	Percent Retained
⅜-inch screen	0 Percent
¼-inch screen	0 Percent - 5 Percent
20 mesh screen	15 Percent - 50 Percent
100 mesh screen	80 Percent - 100 Percent

D. Use Type I cement conforming to ASTM C-150.
E. Mix in a pug mill using not less than 1½ sacks of cement per cubic yard of mixture with sufficient water to hydrate the cement.

PART 3 - EXECUTION

3.1 EXCAVATION

Excavation work shall be unclassified and includes removal of all types of materials encountered without exception. Make excavations to lines and grades indicated on drawings. Complete excavations within the tolerances specified. Perform all work in conformity with the rules and regulations of the Federal Occupational Safety and Health Act. Excavation protection for excavations deeper than 5 feet are governed by trench excavation and protection Section 31 Item 23 33 "Trenching and Backfill".

A. Shoring, Bracing and Dewatering. Provide shoring, bracing and dewatering of excavations required to properly and safely complete the work as shown. Construct shoring and bracing to prevent the excavation from extending beyond specified or indicated limits and to protect workmen. Keep excavations dewatered by drainage, pumps or well points as necessary while work is in progress. Dewatering methods are subject to approval. Remove shoring, bracing and sheathing as excavations are backfilled in a manner to prevent injurious caving.

B. Pipe Trenches. Excavate by open cut methods. Make and maintain the sides of the trench as nearly vertical as practical. Provide shoring to maintain the sides of the trench in a vertical position and to protect workmen. Complete and shape the trench to provide free working space and to permit thorough tamping of backfill around the pipe. Grade trench bottoms accurately to provide uniform bearing on firm soil along the entire length of each pipe section. Remove rubbish, rock or debris encountered at grade to at least six-inches (6") below the bottom of the pipe. Reshape and compact the trench bottom. Working space measured from the outside of the pipe to the side of the trench must be at least six-inches (6") but not more than 24-inches (24"). Provide bell holes where required for making proper connections at joints.

C. Structures Other Than Pipes.

1. (a) Cut all excavations a sufficient distance from walls, shafts or similar elements of structures to allow for placing and removing forms and for inspection.
   (b) Make no excavation beyond a vertical plane three-feet (3') outside of footing lines or wall lines except as shown or specifically authorized.
2. Carry all excavations to the elevations shown and to deeper levels as directed when suitable foundation soils are not encountered at plan depth. Remove all pockets of soft or otherwise unstable soils and replace with concrete or with suitable well compacted soil as directed.
3. Fill all unauthorized excessive excavation with concrete at no change in the contract sum.
4. Protect all open excavations from rainfall or excessive drying. Provide pumps and other equipment as required to keep excavations reasonably free of water at all times and completely free of water during placement of concrete.
5. Do not remove the last four-inch (4") depth of excavation for slabs or footing until reinforcing steel and concrete are ready to be placed.
6. For footings founded on rock, hard shale or similar material, remove all loose material. Clean and cut to a firm surface either level, stepped or serrated as directed. Clean out seams and fill with concrete at the time footing concrete is placed.

3.2 BACKFILL

Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable soils from the excavation as backfill material. Do not use peat or other organic matter, silt, muck, debris or similar materials. Deposit backfill in uniform layers and compact each layer as specified.

A. Backfill at Structures. Place backfill as promptly as practicable after completion of each structure or portion of a structure. Do not however, place backfill against concrete walls or similar structures until concrete has been cured at least seven (7) days. Remove concrete forms before starting backfill and remove shoring and bracing as the work progresses. Take care to prevent any wedging action of backfill against the structure. Step cut or serrate the slopes bounding the excavation as required to prevent wedging.

B. Backfilling of Pipe Trenches.
   1. Do not start backfilling until all pipe joints have been inspected and approved. Remove shoring and bracing before backfilling or as backfilling progresses. When specifically approved, shoring and bracing may be cut off l8 inches below the ground line and left in place.
   2. Place initial backfill in equal layers along both sides of the pipe and carefully tamp to form a uniform bedding. Continue in this manner until the pipe is covered.

C. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to approximately optimum moisture content. Compact with power-driven hand tampers to the prescribed density.
   1. Regular Backfill. Place in eight-inch (8") maximum layers, loose measure. Compact to not less than 95 percent (95%) of maximum dry density as determined by AASHTO Standard Method T-99.
   2. Sand Backfill and Filter Material Backfill. Place in six-inch (6") maximum layers, loose measure. Compact to not less than 95 percent (95%) of maximum dry density as determined by AASHTO Standard Method T-99.
   3. Cement Stabilized Sand Backfill. Place in eight-inch (8") maximum layers. Compact to not less that 95% of maximum dry density as determined by AASHTO Standard Method T-99.

3.3 DISPOSAL OF EXCESS MATERIAL

Dispose of excess or unsuitable material from the excavation off the job site.

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. The work covered by this section consists of excavating and properly utilizing or otherwise satisfactorily disposing of all excavated material, of whatever character, within the limits of the work and the constructing, compacting, shaping, and finishing of all earthwork on the entire length of the street and approaches in accordance with specification requirements herein outlined and in conformity with the required lines, grades, and typical cross sections, shown on the plans.

1.2 CLASSIFICATION

A. All excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed, except those covered by other sections of these specifications.

PART 2 – EXECUTION

2.1 CONSTRUCTION METHODS

A. The subgrade shall be shaped in conformity with the typical sections shown and to the lines and grades established on the plans by the removal of existing material or addition of approved material. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material. All holes, ruts, and depressions shall be filled with approved material. The surface of the subgrade shall be finished to the lines and grades as established, and be in conformity with the typical sections shown on the plans. Any deviation in excess of 0.5 inches in cross section and in a length of 16 vertical feet measured longitudinally shall be corrected by loosening, adding, or removing material, reshaping and compacting by sprinkling and rolling. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of the work.

B. Suitable material removed in one area may be utilized in the addition of material to the subgrade in another area. All material required for completion of the subgrade shall be free of vegetation, humus, debris or other waste material.

C. Excavate to finished subgrade and proofroll in accordance with TxDOT Standard Specifications, Item 216. Scarify subgrade to a uniform depth of 6 in. below finish subgrade. Subgrade materials shall be compacted by approved mechanical tamping equipment to an apparent dry density of the total material of not less than 95 percent of the maximum dry density as determined in accordance with THD Test Method Tex-113-E. Tests for density will be made within 24 hours after compacting operations are completed. Reports shall be submitted to the Government's Contracting Officer. If the material fails to meet the density specified, it shall be re-worked as necessary to obtain the density required. Just prior to placing any base materials, density and moisture content of the top three inches (3in) of compacted subgrade shall be checked and if tests show the density to be more than 2 percent below the specified minimum or the moisture content to be more than three percent above or below the optimum, the course shall be re-worked as necessary to obtain the specified compaction and moisture content. Unsuitable excavation or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor and it shall become his sole responsibility to dispose of this material off the limits of the site.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section includes construction dewatering.
B. Related Sections:
   1. TxDOT Standard Specification, Item 402 "Trench Excavation Protection" for excavating shielding.
   2. Section 31 23 33 "Trench & Backfilling" for shoring, bracing and sheet pilling of excavations.

1.3 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
   1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
   3. Prevent surface water from entering excavations by grading, dikes, or other means.
   4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
   5. Remove dewatering system when no longer required for construction.

1.4 SUBMITTALS

A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
   1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
   2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.
B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
C. Field quality-control reports will be sent to the Project Engineer or the Owner's Representative.
D. Other Informational Submittals:
   1. Photographs or Videotape may be used to show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Preinstallation Conference: Conduct conference at the project site.

1. Review methods and procedures related to dewatering including, but not limited to, the following:
    a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
    b. Geotechnical report.
    c. Proposed site clearing and excavations.
    d. Existing utilities and subsurface conditions.
    e. Coordination for interruption, shutoff, capping, and continuation of utility services.
    f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    g. Testing and monitoring of dewatering system.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Project Engineer or Owner's Representative no fewer than two (2) days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Project Engineer or Owner's Representative written permission.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - EXECUTION

2.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Monitor dewatering systems continuously.

E. Promptly repair damages to adjacent facilities caused by dewatering.
F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section No. 01 57 13 "Temporary Erosion Controls" during dewatering operations.

2.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
   1. Space well points or wells at intervals required to provide sufficient dewatering.
   2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
D. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
E. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
F. Maintain piezometric water level a minimum of 24 inches below surface of excavation.
G. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
H. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
   1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches (900 mm) below overlying construction.
I. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

2.3 FIELD QUALITY CONTROL

A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.
   1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
   2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
   3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION

SECTION 31 23 23

SUBGRADE FILL

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item shall consist of furnishing and placing materials for purposes of stabilizing subgrades in trenches or channels or under conduits or poured-in-place box culverts, where quicksand, muck or other unstable material is encountered. When not specifically called for on the plans, use of this material for any purpose is subject to approval by the Project Engineer or Owner's Representative's Representative.

1.2 CLASSES

A. The subgrade fillers shall be of two (2) classes known as Concrete Subgrade Filler and Gravel Subgrade Filler.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete: Concrete subgrade filler shall be composed of concrete conforming to the provisions of the TxDOT Standard Specifications, Item 401, “Flowable Backfill”.

B. Gravel: Gravel subgrade filler shall be composed of well graded, crushed stone or gravel, one hundred percent (100%) passing a two inch (2") sieve, at least ninety-five percent (95%) passing a one and three quarter inch (1 3/4") sieve and at least ninety percent (90%) retained on a one quarter inch (1/4") sieve.

C. The crushed stone or gravel shall have an abrasion of not more than forty (40) when subjected to the Los Angeles Abrasion Test.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Where the soil encountered in the subgrade for a storm sewer, sanitary sewer, or other structure at established footing or pipe bearing grade is a quicksand, muck, or other unstable material, the Contractor shall remove and replace unstable material to the required depth with one of the fillers specified above. When approved by the Project Engineer or Owner's Representative's Representative, the following procedures shall govern:

B. The concrete subgrade filler will be used to establish a thin working surface on subgrades that are saturated but are regarded as stable, and where otherwise the construction operations would disturb the subgrade surface. In such a case a layer of material to a depth below the established footing or bearing elevation, shall be removed and replaced with the concrete filler material. The material shall be lightly consolidated by tamping and the surface shall be screeded or struck off and allowed to set to form a subgrade surface of accuracy equivalent to that obtained for normal fine grading of subgrade.

C. Gravel subgrade filler will be used to replace wet subgrade or other unstable materials regarded as unsatisfactory for support of the structure involved. In such cases, subgrade material shall be removed to such depth below the established footing or bearing elevation as may be ordered. The soil removed shall be replaced with gravel or crushed stone as subgrade filler, placed in uniform layers of suitable depth. Graded subgrade filler also will be used for initial backfill material for flexible pipe and in rock construction.

END OF SECTION

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section shall govern the excavation, trenching, and backfilling for water main and sanitary sewer construction, unless otherwise noted on the plan details and the specifications. The work shall include all necessary drainage, pumping, bailing, sheeting, shoring and incidental construction. All existing utilities shall be protected from damage during the excavation and backfilling of trenches and, if damaged, shall be replaced by the Contractor at his expense. Unless otherwise shown on the plans, proposal, or contract documents, all excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed.

PART 2 – EXECUTION

2.1 EXCAVATION

A. The Contractor shall perform all excavation of every description and of whatever substances encountered to the lines and grades shown on the plans or determined by the Project Engineer or Owner's Representative. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance from banks of the trench to avoid overloading and to prevent slides or cave ins. All excavated materials not required or suitable for backfill shall be removed and properly disposed of by the Contractor or as directed by the Project Engineer or Owner's Representative. Grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved methods.

B. Sheeting and shoring shall be installed in accordance with safety requirements for the protection of the work, adjoining property, and for the safety of the personnel. Unless otherwise indicated, excavation shall be by open cut. Short sections of a trench may be tunneled, if in the opinion of the Project Engineer or Owner's Representative, the pipe or structure can be safely and properly installed or constructed, and backfill can be properly compacted in such tunnel sections.

1. Blasting: Where permitted, blasting shall be performed in accordance with appropriate criteria established by the National Fire Protection Association [31 TAC 313.5(c)(6)] and all Local, County, State, and Federal codes and ordinances. The Contractor shall be responsible for obtaining all permits at no cost to the Project Engineer or Owner's Representative. Blasting for utility excavation must be done in such a manner as to minimize the fracturing of rock beyond the required excavation. The Contractor shall consider the elevation of utilities in relation to the blasting charge and the relative alignment of existing and proposed trenches. Blasting within such areas shall be accomplished only by qualified Contractors who hold blasting licenses. Any damage to existing utilities resulting from blasting shall be repaired at the Contractor's expense. Sand shall not be used for bedding for backfill in trenches that have been blasted.
2. Archaeological: "Unidentified Archaeological Sites": If the Contractor should encounter a section of an acequia (early Spanish irrigation ditch) or any other archaeological deposits during construction operations, the Contractor must stop excavation immediately and contact Architect or Civil Engineer of record.
3. Provide and maintain barricades, flags, torches, and other safety devices as required by local, state, and federal codes and ordinances and conduct work to create a minimum

inconvenience to the public. Temporary suspension of work does not relieve responsibility for the above requirements.

2.2 TRENCH EXCAVATION SAFETY PROTECTION

A. Trench excavation safety protection in accordance with the most recent provisions of Part 1926, Subpart P - "Excavations, Trenching and Shoring" of the Occupational Safety and Health Administration Standards and Interpretations is to be provided and followed by the Contractor whenever applicable to any aspect of this project.

B. The Contractor should accomplish any excavation and/or trenching performed under this specification in strict accordance with applicable safety procedures and systems.

2.3 TRENCHING

A. Trench walls shall be vertical and the practice of undercutting at the bottom or flaring at the top will not be permitted except where it is justified for safety or at the Project Engineer of Owner's Representative's direction. In special cases where trench flaring is required, the trench walls shall remain vertical to a depth of at least one foot (1') above the top of the pipe.

B. The trench bottom shall be square or slightly curved to the shape of the trenching machine cutters. The trench shall be accurately graded along its entire length to provide uniform bearing and support for each section of pipe on undisturbed soil. Bell holes and depressions for joints shall be dug after the trench bottom has been graded. The pipe shall rest upon the prepared bottom for as nearly its full length as practical.

C. Where over-excavation occurs, the under-cut trench shall be restored to grade at no cost to the Owner's Representative by replacement with a material conforming to the requirements of the bedding material or a material approved by the Project Engineer or Owner's Representative.

D. Whenever wet or otherwise unstable soil that is incapable of properly supporting the structure or pipe is encountered in the bottom of the trench, such soil shall be removed and the trench backfilled to the proper grade with a material conforming to the requirements of the bedding material or a material approved by the Project Engineer or Owner's Representative.

E. The minimum width of pipe trenches, measured at the crown of the pipe, shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width shall be exclusive of trench supports and not greater than the width at the top of the trench.

F. The maximum allowable width of trench for pipelines measured at the top of the pipe shall be the outside diameter of the pipe (exclusive of bells or collars) plus 24 inches. A trench wider than the outside diameter plus 24 inches may be used without special bedding if the Contractor, at his expense, furnishes pipe of the required strength to carry additional trench load. Such modifications shall be submitted to the Project Engineer or Owner's Representative and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the specifications, or by the written approval of the Owner's Representative, the Contractor, at his expense, shall cradle the pipe in concrete or other pipe bedding material approved by the Project Engineer or Owner's Representative.

G. If unsuitable bearing materials such as water, silt, muck, trash, debris or rock in ledge, boulder or coarse gravel (particle size larger than 1-3/4 inch) is encountered at the bearing level, the Contractor shall over-excavate and remove such materials to a depth no less than six inches (6") below the bottom of the pipe and replace with a material conforming to the requirements of "2.4, C, 2., a. Bedding" listed below or as approved by the Project Engineer or Owner's Representative.

H. Dewatering. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.
2. Convey water removed from excavations and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversions outside excavation limits. Do not use trench excavations as temporary drainage ditches.
3. Dewatering devices shall be provided with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the Project Engineer or Owner's Representative shall order immediate shutdown, and remedial measures will be the responsibility of the Contractor.
4. Upon completion of the dewatering work, the Contractor shall remove all equipment and leave the construction area in a neat, clean, and acceptable condition.
5. Maintain ground water table at least 12 inches below the finished excavation subgrade.
6. Performance of the dewatering system for lowering ground water shall be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these shall be read at least daily. The Contractor shall maintain a log of these readings and submit them to the Project Engineer or Owner's Representative.

2.4 BACKFILLING SANITARY SEWER TRENCHES

A. Trenches shall not be backfilled until the construction structures or appurtenances, as installed, conform to the requirements specified. Where specified, backfilling may incorporate excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale or other approved materials, free from large clods of earth or stones. Where pipe is specially coated for protection against corrosion, care shall be taken not to damage the coating.

B. Where a trench has been improperly backfilled, or where settlement occurs, the identified section shall be excavated to the depth and length required, then refilled and compacted to the grade and compaction. The use of sand backfill shall not be allowed. All compaction within the secondary backfill zone shall be such that the apparent dry density of each layer shall be not less than ninety percent (90%) within 2' of top of pavement, with the top 2' being not less than ninety-five percent (95%) for pavement areas of the maximum dry density at + or - 2% optimum moisture content as determined by tests on samples as outlined in TxDOT Testing Method Tex 113-E, unless otherwise shown on the plans. Reports shall be submitted to the Project Engineer or Owner's Representative's Contracting Officer. At the time of compaction, the water content shall be at optimum moisture content, plus or minus two (2) percentage points.

C. See Table 1 at the end of this specification for an outline of the bedding and initial backfill requirements for various pipe types.

1. Sanitary Sewer Backfilling: Backfill for sanitary sewers is divided into three (3) separate zones: (a) bedding: the material in trench bottom in direct contact with the bottom of the pipe; (b) initial backfill: the backfill zone extending from the surface of the bedding to a point one foot (1') above the top of the pipe; and (c) secondary backfill: the backfill zone extending from the initial backfill surface to the top of the trench. Materials and placement for each of the zones shall be as described herein.
    a. Bedding:
        i. Stable Material: Existing stable material present during excavation include: Trench bottom free of water, muck, debris;
            a) Rock in boulder, ledge or coarse gravel (particle size not larger than 1-3/4 inch) formations;

b) Coarse sands and gravels with maximum particle size of 1-3/4 inch, various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive either wet or dry; and
c) Fine sands and clayey gravels, fine sand, sand-clay mixtures, clay and gravel-clay mixtures.

ii. Unstable Material: Existing unstable materials are: Silt, muck, trash or debris in the trench bottom bearing level; rock, in ledge or boulder, or coarse gravel (minimum particle size larger than 1-3/4 inch) formations.

iii. Bedding Material: The existing material at the bearing level shall be removed and replaced to a minimum depth of six inches (6") or one-eighth (1/8) of the outside diameter of the pipe, whichever is greater, with bedding material. The bedding material shall extend up the sides of the pipe sufficient to embed the lower quadrant of the pipe. The bedding material shall be composed of well graded, crushed stone or gravel conforming to the following requirements unless modified by the Project Engineer or Owner's Representative.

Sewer Gravel	Percent
Passing 1-1/2 inch sieve	100
Passing 1 inch sieve	95 to 100
Passing 3/8 inch sieve	25 to 60
Passing No. 4 sieve	0 to 10
Passing No. 8 sieve	0 to 5

iv. Over Excavation: Where the trench bottom has been over excavated beyond the limits as defined in Section 33 31 13, "Site Sanitary Utility Sewage Piping," due to blasting or removal or unstable material, the pipe shall be concrete encased. Encasement shall extend from the trench wall to trench wall and be a minimum of six inches (6") above the top of pipe.

b. Initial Backfill: Initial backfill is defined as backfill having a thickness in its compacted state from the surface of the bedding to a point one foot (1') above the top of the pipe.

i. Initial backfill shall consist of gravel that conforms to the requirements "Bedding Material" listed above.

ii. For sewer lines up to inches (24") in diameter initial backfill material shall be placed in two (2) lifts. The first lift shall be spread uniformly and simultaneously on each side and under the bottom quadrant of the pipe to the mid-point or spring line of the pipe.

iii. Placement of the first lift of initial backfill shall be inspected and approved prior to placement of the second lift. The second lift shall extend from the spring line of the pipe to a minimum of one foot (1') above the top of the pipe. The second lift shall be evenly spread in a similar manner as the first lift.

iv. For diameters twenty-four inches (24") and larger, initial backfill material shall be evenly and simultaneously spread alongside, under the lower quadrant the pipe and over the pipe in twelve-inch (12") lifts to a point sufficient to a minimum of one foot (1') above the top of the pipe.

v. No mechanical or hand compaction will be required on an approved initial backfill material when the pipe diameter is less than thirty-six (36) inches.

Initial backfill shall be mechanically or hand compacted in all other conditions.

c. Secondary Backfill: Secondary backfill is defined as backfill from one foot (1') above the top of the pipe to the top of the trench. Secondary backfill shall be constructed in accordance with details shown on the plans and these specifications.
   i. Secondary backfill shall generally consist of materials removed from the trench and shall be free of brush, debris and trash. No rock or stones having any dimension larger than six inches (6") at the largest dimension shall be used in the secondary backfilling zone. Secondary backfill material shall be primarily composed of compactable soil materials. The secondary backfill material shall be placed in maximum twelve inch (12") loose lifts or as directed by the Project Engineer or Owner's Representative.
   ii. All compaction shall be such that the apparent dry density of each layer shall be not less than ninety-five percent (95%) of the maximum dry density as determined by tests on samples as outlined in TxDOT Testing Method Tex 113-E, unless otherwise shown on the plans. Reports shall be submitted to the Project Engineer or Owner's Representative's Contracting Officer.

2.5 BACKFILLING POTABLE WATER TRENCHES

A. Mains and service line trenches shall be excavated in accordance with "Excavation" and "Trenching" listed above for placement of potable water appurtences.
   1. Bedding/Initial Backfill: The bedding and initial backfill materials for concrete steel cylinder pipe (CSC), ductile iron pipe (DI), and Polyvinyl Chloride Pipe (PVC) in all nominal diameters shall be composed of a minimum of 6 inches of natural sand or sand produced from crushed gravel or crushed rock maximum 1/4-inch; 95 percent shall pass No. 4 sieve, free from clay and organic material, with a maximum 8 percent passing the No. 200 sieve, unless modified by the Project Engineer or Owner's Representative.
      a. Thickness of materials lifts and compaction of initial backfill materials shall be in accordance with the provisions of "Initial Backfill" and "Bedding/Initial Backfill" listed above.
      b. Where services 3/4" - 2" copper are installed, initial backfill shall be sand conforming to the following requirements: Natural sand or sand produced from crushed gravel or crushed rock maximum 1/4-inch; 95 percent shall pass No. 4 sieve, free from clay and organic material, with a maximum 8 percent passing the No. 200 sieve.
      c. A minimum 20 mil thick bonded coating shall be installed on all buried metallic gas, water, fire protection, pipes, valves, fittings, hydrants, building risers per I.A.W. Air Force AFI 32-1054, AWWA C-203, C-209, C-214, NACE RPO169, RPO190, MRO274. Note: Unbonded coating such as loose polyethylene wraps and or sleeves are not allowed by the Air Force.
      d. A #10 AWG tracer wire shall be installed with all non-metallic gas and water lines. The wire shall be taped to the pipe every 20 feet, be continuous, and accessible above ground at all main valves and hose bibs.
   2. Secondary Backfill: Secondary backfill materials for all types and sizes of pipe shall be as defined in "Secondary Backfill" listed above. Secondary backfill materials shall be placed and compacted in accordance with the provisions of "Secondary Backfill" listed above.

2.6 DISPOSAL OF EXCAVATED MATERIALS

A. Any excess excavated material, not utilized after all fill requirements have been met, shall become the responsibility of the Contractor. The Contractor shall dispose of it by hauling and wasting outside the limits of this project and of public thoroughfares and water courses, in

conformity with pertinent City, County, State, and Federal codes and ordinances and in a manner meeting the approval of the Project Engineer or Owner's Representative.

BEDDING AND INITIAL BACKFILL REQUIREMENTS

	UNSTABLE		**STABLE***		**ROCK**	
	Bedding	**Initial Backfill**	**Bedding**	**Initial Backfill**	**Bedding**	**Initial Backfill**
WATER	6"	1.0’ above pipe	6"	1.0'	6"	1' above pipe
CSC	modified grade 5	modified grade 5	modified grade 5	modified grade 5	modified grade 5	modified grade 5
DI	modified grade 5	modified grade 5	modified grade 5	modified grade 5	modified grade 5	modified grade 5
PVC	modified grade 5	modified grade 5	modified grade 5	modified grade 5	modified grade 5	modified grade 5
SEWER	6"	1.0' above pipe	6"	1.0'	6"	1.0'
RIGID	sewer gravel	sewer gravel	sewer gravel	sewer gravel	sewer gravel	sewer gravel
FLEXIBLE	sewer gravel	sewer gravel	sewer gravel	sewer gravel	sewer gravel	sewer gravel

* When the native materials encountered are clean sand, this material may be utilized for bedding and initial backfill at the Project Engineer or Owner's Representative's direction.

END OF SECTION

SECTION 31 32 13.19

LIME TREATMENT - SUBGRADE

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item shall consist of treating the subgrade by the pulverizing, addition of lime, mixing and compacting the mixed material to the required density. This item applies to both natural ground or embankment type subgrades and shall be constructed as specified herein and in conformity with the typical sections, lines and grades as shown on the plans.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Lime for this item shall conform to the requirements for "Type A, Hydrated Lime", of Item No. 264 "Hydrated Lime and Lime Slurry" of the TxDOT Standard Specifications.

2.2 EQUIPMENT

A. The machinery, tools and equipment necessary for proper prosecution of the work shall be on the project and approved by the Project Engineer or Owner's Representative prior to the beginning of construction operations. All machinery, tools and equipment used shall be maintained in a satisfactory and workman-like manner.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Construction methods employed shall conform to article 260.4 "Construction Methods" of Item No. 260, "Lime Treatment for Materials in Place" of the Texas Highway Department Standard Specifications except as follows:
   1. Article 260.4 Paragraph (2)(a) "Dry Placing" may be used only where shown on the plans, or when permitted by the Project Engineer or Owner's Representative.
   2. Compaction shall be by the "Density Control" method only.

B. All other technical requirements indicated under Item No. 260, "Lime Treatment for Materials in Place" of the TxDOT Standard Specifications, shall remain in full force and no other clauses or paragraphs are deleted, altered or replaced.

C. Subgrade soils of paved areas shall be tested to determine the optimum quantity of hydrated lime required for stabilization subject to the approval of the Project Engineer or Owner’s Representative. Reports shall be submitted to the Project Engineer or Owner's Representative. This quantity is estimated in the plans and geotech report.

END OF SECTION

SECTION 31 37 00

RIP-RAP

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item shall consist of cast in place concrete rip-rap, furnished in accordance with the details, sections, lines and grades shown on the plans, reinforced as shown thereon, complete with respect to all materials and workmanship in accordance with these specifications.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete: All concrete shall conform to the provisions of Section No. 03 30 00.01, "Civil Cast in Place Concrete" or shall be of the class as noted on the plans.

B. Reinforcing Steel: All reinforcing steel shall conform to the provisions of Section No. 03 20 00 "Civil Concrete Reinforcement".

C. Expansion Joint Materials: All expansion joint materials shall conform to the provisions of TxDOT Standard Specifications, Item 454 "Bridge Expansion Joint".

D. Membrane Curing Compound: All membrane curing compound shall conform to the provisions of the TxDOT Standard Specifications, Item 420, "Concrete Substructures".

E. Stone: Use durable natural stone with a bulk specific gravity of at least 2.50 as determined by Tex 403 A unless otherwise shown on plans. Provide stone that when tested in accordance with Tex 411A, has weight loss of no more than 18% after 5 cycles of magnesium sulfate solution.

a. Common:

i. Use stones between 50 and 250 lb. Use stones that are at least 3 in. in their least dimension. Use stones that are at least twice as wide as they are thick. When shown on the plans or approved, material may consist of broken concrete removed under the Contract or from other approved sources. Cut exposed reinforcement flush with all surfaces before placement of each piece of broken concrete.

b. Protection:

i. Use boulders or quarried rock that meets the gradation requirements of the TxDOT Standard Specifications, Item 432, Table 1. Both the width and the thickness of each piece of riprap must be at least 1/3 of the length. When shown on the plans or as approved, material may consist of broken concrete removed under the Contract or from other approved sources. Cut exposed reinforcement flush with all surfaces before placement of each piece of broken concrete. Determine gradation of the finished, in-place, riprap stone under the direct supervision of the Engineer in accordance with ASTM D5519.

c. Cement Stabilized Riprap

i. Provide aggregate that meets the TxDOT Standard Specifications Item 247, “Flexible Base” for the type and grade shown on the plans. Use cement-stabilized riprap with 7% hydraulic cement by dry weight of the aggregate.

d. Type R:

i. Use stoned between 50 and 250 lbs. with at least 50% of the stones heavier than 100 lb.

e. Type F:

i. Use stones between 50 and 250 lb. with at least 40% of the stones heavier than 100 lb.

ii. Use stones with at least 1 broad flat surface.

F. Filter Fabric: All filter fabric should be in accordance with DMS 6200, "Filter Fabric". Provide Type 2 filter fabric for protection stone riprap unless otherwise shown on the plans. Provide Type 2 filter fabric for Type R, F, or Common stone riprap when shown on the plans.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Concrete Riprap:
   a. The concrete rip-rap shall be reinforced as shown on the plans. All reinforcements, including dowels, shall be properly and adequately supported throughout the placement of concrete. Dowel bars or reinforcement protruding from existing rip-rap shall be thoroughly cleaned.
   b. All earthen surfaces on which the rip-rap is to rest shall be accurately excavated and graded to provide a firm bedding for the rip-rap. If the slopes and bottom of the trench for toewalls are dry and not consolidated properly, the entire area should be sprinkled and consolidated before the concrete is placed. All surfaces shall be moist when concrete is placed. It is the intent that the finished surface of the rip-rap be a continuation of the finished surface of the channel or embankment which it is to protect. All excavation for toe walls shall, to the extent practicable, be made to the neat lines of the concrete sections.
   c. The new rip-rap shall be doweled into all concrete that abuts it, both new and existing. Weep holes and graded fill shall be constructed as shown on the plans or as directed by the Project Engineer or Owner's Representative.
   d. Expansion joint material, one-half inch (1/2") thick, shall be provided where the new construction abuts existing construction. The expansion joint material shall be placed vertically and shall extend the full depth of the concrete. Similar expansion material shall be placed around all obstructions protruding through the concrete rip-rap.
   e. After concrete has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to a smooth and uniform finish, and exposed edges shall be tooled. Immediately after finishing the rip-rap, the surface shall be protected by a membrane curing compound.
   f. If the Contractor so elects, an air entraining admixture, may be employed to facilitate the placement and finish of the rip-rap. The entrained air range shall be from 3 to 6 percent.

B. Stone Riprap
   a. Provide the following types of stone riprap when shown on the plans:
      i. Dry Riprap. Stone riprap with voids filled with only spalls or small stones.
      ii. Grouted Riprap. Type R, F, or Common stone riprap with voids grouted after all the stones are in place.
      iii. Mortared Riprap. Type F stone riprap laid and mortared as each stone is placed.
   b. Use spalls and small stones lighter than 25 lb. to fill open joints and voids in stone riprap, and place to a tight fit.
   c. Place mortar or grout only when the air temperature is above 35°F. Protect work from rapid drying for at least 3 days after replacement.
   d. Place filter fabric with the length running up and down the slope unless otherwise approved. Ensure fabric has a minimum overlap of 2 ft. Secure fabric with nails or pins. Use nails at least 2 in. long with washers or U-shaped pins with legs at least 9 in. long. Space nails or pins at a maximum of 10 ft. in each direction and 5 ft. along the seams. Alternative anchorage and spacing may be used when approved.

e. Type R
   i. Construct riprap as shown in Figure 1 on the Stone Riprap Standard and as shown on the plans. Place stones in a single layer with close joints so most of their weight is carried by the earth and not the adjacent stones. Place the upright axis of the stones at an angle of approximately 90° to the embankment slope. Place each course from the bottom of the embankment upward with the larger stones in the lower courses.
   ii. Fill open joints between stones with spalls. Place stones to create a uniform finished top surface. Do not exceed a 6 in. variation between the tops of adjacent stones. Replace, embed deeper, or chip away stones that project more than the allowable amount above the finished surface.
   iii. Prevent earth, sand, or foreign material from filling the spaces between the stones when the plans require Type R stone riprap to be grouted. Wet the stones thoroughly after they are in place, fill the spaces between the stones with grout, and pack. Sweep the surface of the riprap with a stiff broom after grouting.

f. Type F
   i. Dry Placement. Construct riprap as shown in Figure 2 on the Stone Riprap Standard. Set the flat surface on a prepared horizontal earth bed, and overlap the underlying course to secure a lapped surface. Place the large stones first, roughly arranged in close contact. Fill the spaces between the large stones with suitably sized stones placed to leave the surface evenly stepped and conforming to the contour required. Place stone to drain water down the face of the slope.
   ii. Grouting. Construct riprap as shown in Figure 3 on the Stone Riprap Standard. Size, shape, and lay large flat-surfaced stones to produce an even surface with minimal voids. Place stones with the flat surface facing upward parallel to the slope. Place the largest stones near the base of the slope. Fill spaces between the larger stones with stones of suitable size, leaving the surface smooth, tight, and conforming to the contour required. Place the stones to create a plane surface with a variation no more than 6 in. in 10 ft. from true plane. Provide the same degree of accuracy for warped and curved surfaces. Prevent earth, sand, or foreign material from filling the spaces between the stones. Wet the stones thoroughly after they are in place, fill the spaces between them with grout, and pack. Sweep the surface with a stiff broom after grouting.
   iii. Mortaring. Construct riprap as shown in Figure 2 on the Stone Riprap Standard. Lap courses as described for dry placement. Wet the stones thoroughly before placing mortar. Bed the larger stones in fresh mortar as they are being place and shove adjacent stones into contact with one another. Spread excess mortar forced out during placement of the stones uniformly over them to fill all voids completely. Point up all joints roughly either with flush joints or shallow, smooth-raked joints as directed.

g. Common
   i. Construct riprap as shown in Figure 4 on the Stone Riprap Standard. Place stones on a bed excavated for the base course. Bed the base course of stone well into the ground with the edges in contact. Bed and place each succeeding course in even contact with the preceding course. Use spalls and small stones to fill any open joints and voids in the riprap. Ensure the finished surface presents an even, tight surface, true to the line and grades of the typical sections.
   ii. Prevent earth, sand, or foreign material from filling the spaces between the stones when the plans require grouting common stone riprap. Wet the stones thoroughly after they are in place; fill the spaces between them with grout; and pack. Sweep the surface with a stiff broom after grouting.

h. Protection
    i. Construct riprap as shown in Figure 5 on the Stone Riprap Standard. Place riprap stone on the slopes within the limits shown on the plans. Place stone for riprap on the filter fabric to produce a reasonably well-graded mass of riprap with the minimum practicable percentage of voids. Construct the riprap to the lines and grades shown on the plans or staked in the field. A tolerance of +6 in. and −0 in. from the slope line and grades shown on the plans is allowed in the finished surface of the riprap. Place riprap to its full thickness in a single operation. Avoid displacing the filter fabric. Ensure the entire mass of stones in their final position is free from objectionable pockets of small stones and clusters of larger stones. Do not place riprap in layers, and do not place it by dumping it into chutes, dumping it from the top of the slope, pushing it from the top of the slope, or any method likely to cause segregation of the various sizes. Obtain the desired distribution of the various sizes of stones throughout the mass by selective loading of material at the quarry or other source or by other methods of placement that will produce the specified results. Rearrange individual stones by mechanical equipment or by hand if necessary to obtain a reasonably well-graded distribution of stone sizes. Use the bedding thickness shown and place stone for riprap on the bedding material to produce a reasonably well-graded mass of riprap with the minimum practicable percentage of voids if required on the plans.

i. Cement-Stabilized Riprap
    i. Follow the requirements of the plans and the provisions for concrete riprap except when reinforcement is not required. The Engineer will approve the design and mixing of the cement-stabilized riprap

END SECTION

SECTION 31 63 29
DRILLED PIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Dry-installed drilled piers.

B. Work Included
   1. Furnish all labor and materials required to construct drilled concrete piers complete including layout, excavation of shafts, excavation of belled bottoms, temporary steel casings, fabrication and installation of reinforcing steel, furnishing and placing concrete, setting anchor bolts and removal of spoil.

C. Related Sections include the following:
   1. Division 1 Section "Temporary Facilities and Controls."
   2. Division 3 Section "Cast-in-Place Concrete" for concrete materials and steel reinforcement.

1.3 UNIT PRICES

A. Basis of Bids: Base bids on indicated number of drilled piers; design length from top elevation to bottom of shaft; and diameter of shaft.

B. Basis for Payment: Payment for drilled piers will be made on actual net volume of drilled piers in place and approved. Actual length and shaft diameter may vary to coincide with elevations where satisfactory bearing strata are encountered, and with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts.
   1. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, and other items for complete drilled-pier installation.
   2. See Division 1 Section "Unit Prices" for list of unit prices.

C. Contract price shall be based on base lengths of piers shown on the Drawings. Unit prices shall be as follows:
   1. Unit prices per linear foot for piers longer or shorter than base lengths.
   2. Unit prices per linear foot for casing. Measurement for payment shall be from top of pier to top of bearing stratum.

D. Unit prices shall include all labor and materials including overhead and fees for drilled concrete piers. Adjustments to the Contract shall be based on total linear feet greater than or less than the sum of the base lengths of each pier size. Additional penetration in the bearing stratum greater than the specified penetration shall not be included in determination of increases or decreases of pier lengths related to adjustments in the Contract.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate dimensioned plan layout, dowel and anchor bolt setting plans including templates, drilled pier shaft sizes, and top elevation, and details of reinforcing steel.

B. Submittals for Information:
   1. Pier Drilling Log: Report of drilled concrete pier construction including actual elevations of top and bottom of each pier, elevation of bearing stratum, penetration into bearing stratum, deviations of pier centerline and plumbness, shaft size, presence of water, use of temporary casing, placement of concrete, and time of start and finish of excavation

C. Product Data: For each type of product indicated.

D. Design Mixes: For each class of concrete. Include revised mix proportions when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Laboratory Test Reports: For evaluation of concrete materials and mix design.

E. Record drawings at Project closeout according to Division 1 Section "Closeout Procedures."

1.5 QUALITY ASSURANCE

A. Installer: Company specializing in performing the work of this Section with minimum three projects in similar soil and rock conditions, and with similar shaft sizes, depths, and quantities.

B. Drilled-Pier Standard: Comply with provisions in ACI 336.1, "Reference Specifications for the Construction of Drilled Piers," unless modified in this Section.

C. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
   1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

D. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 to perform material evaluation tests and to design concrete mixes, as documented according to ASTM E 548.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Quality Requirements."

1.6 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
   1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Site Information: A geotechnical report has been prepared for this Project and is included elsewhere in the Project Manual for information only.

1. Information regarding site conditions is provided for the convenience of the Contractor and is not a warranty that the information represents site conditions that may be encountered. The Owner shall not be responsible for interpretations or conclusions drawn from the information provided by the Contractor.
2. Additional borings or other exploratory work may be conducted by the Contractor at no cost to the Owner.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Refer to Division 03 Section "Cast In Place Concrete."

B. Bar Supports: Furnish spacers to maintain required concrete cover to sides and bottom of excavation.
   a. Shaftspacer Systems and "BARBOOT Rebar Supports", Foundation Technologies, Inc., Tucker, Georgia.
   b. "Centraligner" and "Hijacker", Pieresearch, Arlington, Texas.

2.2 CONCRETE MATERIALS

A. Provide concrete materials in accordance with Division 3 "Cast-in-Place Concrete."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

A. Unclassified Excavation: Excavation is unclassified and includes excavation to bearing elevations regardless of character of materials or obstructions encountered.
   1. Obstructions: Unclassified excavation includes removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions.
      a. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

B. Excavate shafts for drilled piers to indicated diameters and elevations. Remove loose material from bottom of excavation.
   1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
   2. Remove water from excavated shafts before concreting.
   3. Excavate rock sockets of dimensions indicated.

C. Notify and allow Owner's testing and inspecting agency to test and inspect bottom of excavation prior to placing reinforcement and concrete. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
   1. Do not excavate shafts deeper than elevations indicated, unless approved by Architect.
   2. Additional authorized excavation will be paid according to Contract provisions for changes in the Work.

D. Excavate shafts for closely spaced drilled piers and those occurring in fragile or sand strata, only after adjacent drilled piers are filled with concrete and allowed to set.

E. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
   1. Maximum Variation From Vertical: One percent of length.
   2. Maximum Variation From Design Top Elevation: Plus 1 inch to minus 3 inches.
   3. Maximum Out-of-Position: One twenty-fourth of the shaft diameter or 3 inches, whichever is less.
   1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

F. Inspection: Each drilled pier must be inspected and tested by Owner's testing and inspecting agency before placing concrete.
   1. Provide and maintain facilities with equipment required for testing and inspecting excavations. Cooperate with testing and inspecting personnel to expedite the Work.
   2. Notify Architect and testing agency at least six hours before excavations are ready for tests and inspections.

3.3 STEEL REINFORCEMENT

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
   1. Concrete shall be placed within the time limit stated on the Drawings.
   2. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
   1. Where concrete cannot be directed down shaft without striking reinforcing, place concrete with chutes, tremies, or pumps. Use tremies where a drop of more than 25’-0” is required.
   2. Vibrate top 60 inches of concrete.

C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
   1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
   1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit reports during excavation and concrete placement for drilled piers.

B. A drilled-pier report will be prepared by Owner's testing and inspecting agency for each drilled pier as follows:
   1. Actual top and bottom elevations.
   2. Top of rock elevation.
   3. Description of soil materials.
   4. Description, location, and dimensions of obstructions.
   5. Final top centerline location and deviations from requirements.
   6. Variation of shaft from plumb.
   7. Shaft excavating method.
   8. Design and tested bearing capacity of bottom.
   9. Depth of rock socket.
   10. Levelness of bottom and adequacy of cleanout.
   11. Ground-water conditions and water-infiltration rate, depth, and pumping.
   12. Description, diameter, and top and bottom elevations of temporary or permanent casings.
   13. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
   14. Date and time of starting and completing excavation.
   15. Inspection report.
   16. Position of reinforcing steel.
   17. Concrete placing method, including elevation of consolidation and delays.
   18. Elevation of concrete during removal of casings.
   19. Locations of construction joints.
   20. Remarks, unusual conditions encountered, and deviations from requirements.
   21. Concrete testing results.

C. Concrete: Refer to Section 03 30 00 for sampling and testing of concrete for quality control.

1. Strength level of concrete will be considered satisfactory if averages of sets of 3 consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
2. Test results will be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests will contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in drilled pier, design compressive strength at 28 days, concrete-mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
3. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as sole basis for acceptance or rejection.
4. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate concrete strengths or other requirements have not been met.

3.6 DISPOSAL OF MATERIALS

A. Remove surplus excavated material and slurry and legally dispose of it off Owner's property.

END OF SECTION

SECTION 32 01 90

OPERATION & MAINTENANCE OF PLANTING

PART 1 – GENERAL

1.01 Scope

A. Maintenance required under this contract shall conform to the specifications and criteria in this section. Items included in this section include, but are not limited to, the following:

1. Application of pesticides, as required

2. Weeding, cultivating and cleaning of all plantings

3. Application of herbicides

4. Adjustment of irrigation clocks for weather and growth conditions

5. General site clean-up. Removal of trash and products of maintenance

6. Truck watering of trees, turf, and shrubs via manual system

1.02 Contract Period

A. These specifications shall govern all maintenance work by the contractor on completed, partially completed, and area to be completed of the project. Maintenance shall be commencing at the Notice to Proceed and terminating at 90 days (or as specified by owner) after the issuance of Notice of Substantial Completion.

1.03 Intent of the Contract

A. It is the intent of the contract to provide the owner with a project site that is attractive in appearance, and to keep all plant materials and lawns in a healthy and vigorous condition.

1.04 Contractor's Performance

A. The contractor shall perform all work as often as necessary to fulfill the spirit and intent of the contract. The workmen shall be neat in appearance, perform their work in a professional manner, keep noise to a minimum, and stage their work from a location on the site out of the way of the mainstream of the users. In general, the contractor's presence on the site shall be as inconspicuous as possible.

1.05 Neglect and Vandalism

A. Turf, shrubs, trees or plants that are damaged or killed due to contractor's operations, negligence, or chemicals shall be replaced at no expense to the owner.

B. Sprinklers or structures that are damaged due to the contractor's operation must be replaced by the contractor promptly.

C. All damage to, or thefts of landscape elements not caused or allowed by the contractor subsequent to the issuance of the Certificate of Substantial Completion shall be corrected by the contractor at the owner's expense, upon receipt of written authorization to proceed.

D. Damage due to thefts or vandalism prior to the date of the Certificate of Substantial Completion shall be at the contractor's expense.

1.06 Emergencies

A. The contractor shall answer emergency or complaint calls regarding conditions in landscaped areas regarding fallen trees or branches, or shrubs or trees that obstruct the driveways, and shall correct the problem or place warning signs and advise the owner of the need for major work to be performed.

PART 2 - MATERIALS

2.01 Machinery

A. Machinery requirements listed under this section are not intended to be restrictions of specific manufacturers or models unless so stated. Specific mention of manufacturers is intended as a guide to illustrate the final product of maintenance operations desired.

1. Pruning Tools

a. Shall be maintained in good working order.

b. Cutting edges shall be sharp.

c. Disinfect all tools when used for the removal of diseased limbs with a solution of Clorox and water, mixed at a 1:5 ratio.

2. Watering Truck & Pump

a. Minimum 1200 gal. tank/pump.

b. Pressure at nozzle: 35 PSI (1 1/2" outlet).

PART 3 - EXECUTION

3.01 General

A. All maintenance operations shall be performed by the contractor's own force, superintended by personnel familiar with the job. Subcontracting of maintenance work shall not be allowed.

B. Maintenance period shall commence immediately upon the issuance of the contract. It will be the contractor's sole responsibility to maintain plantings in original intended condition throughout the maintenance period of this contract.

C. Accidental damage to the landscape plantings beyond the control of the contractor shall be reported immediately to the owner.

3.02 Irrigation System

A. Irrigation system maintenance shall generally be construed as any activity or activities necessary to keep the system 100% operational. Irrigation system maintenance shall include, but not be limited to:

1. Replacement of equipment damaged by contractor operations.

2. Repair of other equipment damaged or malfunctioning on a time and material basis.

3. Adjustment and cleaning of heads so as to correct miss directional throw, improper coverage and damage to equipment.

B. The contractor shall monitor and program the irrigation controllers to maintain optimum moisture levels in all planted areas.

C. Irrigation cycles shall be set to take place after 10:00 pm and prior to sunrise (4:00 am - 5:00 am), unless otherwise instructed by the owner, except during visits of grounds maintenance personnel. During such visits, the irrigation system may be operated as desired by those personnel.

D. Irrigation cycles should gradually be reduced from September to the winter, in order to generally reduce late season plant growth and vigor, and to stimulate hardening off and dormancy of plant material.

E. Drip tubing should be covered with a minimum of 3” mulch at all times. Replenish mulch as needed for complete and continuous coverage.

3.03 Staking and Guying

A. Contractor shall maintain staking and guying of trees at all times and shall be responsible for any damage to trees or plant materials caused by chafing or breaking of foliage or limbs coming in contact with stakes, ties, guys, eye bolts, or bracing materials. Periodically, adjust broken stakes and ties as needed. If ties are too tight, they must be replaced or adjusted. All labor and material costs shall be considered in base bid for the initial maintenance period.

B. Trees and large shrubs that may require guys, stakes or special care during the winds and rains shall receive the required care prior to and immediately after anticipated and actual occurrences, to insure no damage results to the plant material.

C. Contractor shall consult with owner/representative to determine if staking material should be removed.

3.04 Pruning

A. Contractor shall prune regularly, as required. Remove dead wood and aesthetically balance the planting, as directed by the landscape architect. All suckers and undesired growth shall be removed immediately. No trees or ornamental trees (i.e., Crape Myrtles) are to be ‘topped-off’, for any reason.

B. Do not prune limbs from trunks more than 12" above ground per 1" caliper (min. 8").

C. Pruning of shrubs should create a uniformly dense plant. Selectively thin and tip back annually. Prune to enhance natural branching effect of plants. Do not change shape of shrubs by pruning. Refer to schedule.

3.06 Manual Watering *(Quick Coupler System)*

A. Water all plant material twice weekly or as necessary to maintain materials in thriving condition. Frequency may be reduced, as directed by the Landscape Architect during periods of wet weather.

container size	water quantity
65 gallon	30 gallons
30 gallon	16 gallons
15 gallon	10 gallons
10 gallon	7 gallons
5 gallon	4 gallons
3 gallon	2 gallons
1 gallon	2 gallons
Seedlings, 4" pot and plugs	½ gallon

3.07 General Clean Up

A. The contractor shall dispose of all waste materials or refuse from his operations off the property, except where other arrangements have been made with the owner.

B. Keep all expansion and score joints free of any vegetation which may appear, and apply appropriate herbicide to discourage future growth in these areas.

C. Leaves, papers, grass clippings or other debris shall be removed weekly, or at each visit from all areas.

D. Remove dead animals from the site immediately, as they are encountered.

PART 4 - SCHEDULE

4.01 Schedules

A. The schedule as included herein shall be used as a guide for the work specified, which may fall within the post-construction maintenance period. Should the contractor require an alteration of the schedule, contact the landscape architect.

SCHEDULE

FUNCTIONS	FREQUENCY											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
Debris Removal	2	2	3	4	4	4	4	4	4	4	4	4
Pruning		1								1		
Weed Control Beds			1	1	1	1	1	1	1	1	1	
Clean/Sweep Curbs/Gutters	2	2	4	4	4	4	4	4	4	4	4	4
Index Irrigation	1	1	1	1	1	1	1	1	1	1	1	1

END OF SECTION

SECTION 32 12 13

PRIME COATS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Prime coat shall consist of an application of asphaltic material on the completed base course and/or other approved areas in accordance with these specifications.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The asphaltic material for Prime Coat shall meet the requirements for Medium Curing Type Cut-Back Asphalt, Grade 30 (MC-30), TxDOT Standard Specifications Item 310, “Prime Coat”, and shall conform to the requirements of TxDOT Standard Specifications Item 300, "Asphalts, Oils and Emulsions".

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. When the area and/or base is completed to the required cross section and compaction as evidenced by passing testing lab reports, the surface shall be cleaned by sweeping or other approved methods. If necessary, the surface shall be lightly sprinkled with water just prior to application of the asphaltic material. The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor so operated as to distribute the prime coat at a rate not to exceed 0.20 gallon per square yard of surface, evenly and smoothly, under a pressure necessary for proper distribution. During the application of prime coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures.

B. The application temperature for prime coat "MC-30" shall be between 70° and 150° Fahrenheit and should be adjusted within the range upward or downward to compensate for the ambient air temperature and result in a material that flows evenly during application.

C. Prime Coat shall not be applied when the air temperature is below 60°F and falling, but it may be applied when the air temperature is above 50°F and is rising; the air temperature being taken in the shade and away from artificial heat.

D. The Contractor shall be responsible for the maintenance of the surface until the work is completed.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item shall consist of a base course, a leveling-up course, a surface course or any combination of these courses as shown on the plans, each to be composed of a compacted mixture of mineral aggregate and asphaltic material. The pavement shall be constructed on the previously completed subgrade and base as herein specified and in accordance with the details shown on the plans.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Materials used in Hot Mix Asphaltic Concrete Pavement shall meet the requirements as set forth in TxDOT Standard Specifications Item 340, "Hot Mix Asphaltic Concrete Pavement".

2.2 PAVING MIXTURES

A. Paving mixtures used shall be Types B, C, D or F, as shown on the plans. These mixtures shall conform to the requirements of TxDOT Standard Specifications paragraph 340.3 of Item No. 340, "Hot Mix Asphaltic Concrete Pavement", except as follows:
   1. Article 340.2 "Material", paragraph (2)(a) shall be supplemented with the following:
      a. The asphaltic material for the paving mixture shall be Asphalt Cement Grade 10 (AC-10).
   2. Part (2) of paragraph 340.3 (Stability and Density) shall be revised as follows:
      a. The mixture when designed and tested in accordance with these specifications and methods *outlined* in applicable THD Bulletins shall have the following density and stability.

DENSITY, PERCENT			STABILITY, PERCENT
Min.	Max.	Optimum	Not less than 40 nor more than 60
94	99	97	Unless otherwise shown on the plans.

   3. Article 340.6 "Construction Methods", paragraph (6)(c) shall be revised as follows:
      a. In-Place Density. In-place density control is required for all mixtures. Asphaltic concrete should be placed and compacted to contain from 3 to 6 1/2 percent air voids as calculated using the *maximum* theoretical specific gravity of the mixture determined according to TEX-227-F. No other technical requirements are waived or changed hereby.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Construction methods used in laying Hot Mix Asphaltic Concrete Pavement shall meet the requirements as set forth TxDOT Standard Specifications Item 340, "Hot Mix Asphaltic Concrete Pavement (Class A)".

END SECTION

SECTION 32 13 13

CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Construct hydraulic cement concrete pavement with or without curbs on the concrete pavement.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hydraulic Cement Concrete

1. Provide hydraulic cement concrete in accordance with TxDOT Standard Specifications Item 421, "Hydraulic Cement Concrete." Use compressive strength testing unless otherwise shown on the plans. Provide Class P concrete designed to meet a minimum average compressive strength of 3,200 psi or a minimum average flexural strength of 450 psi at 7 days or a minimum average compressive strength of 4,000 psi or a minimum average flexural strength of 570 psi at 28 days. Test in accordance with Tex-448-A or Tex-418-A.

2. Obtain written approval if the concrete mix design exceeds 520 lb. per cubic yard of cementitious material.

3. Use coarse aggregates for continuously reinforced concrete pavements to produce concrete with a coefficient of thermal expansion not more than 5.5×10^{-6} in./in./°F. Provide satisfactory Tex-428-A test data from an approved testing laboratory if the coarse aggregate coefficient of thermal expansion listed on the Department's *Concrete Rated Source Quality Catalog* is not equal to or less than 5.5×10^{-6} in./in./°F.

4. Provide Class HES concrete for very early opening of small pavement areas or leave-outs to traffic when shown on the plans or allowed. Design Class HES to meet the requirements of Class P and a minimum average compressive strength of 3,200 psi or a minimum average flexural strength of 450 psi in 24 hr., unless other early strength and time requirements are shown on the plans or allowed.

5. Use Class A or P concrete meeting the requirements of TxDOT Standard Specifications, Item 421, "Hydrualic Cement Concrete," and this Item for curbs that are placed separately from the pavement.

B. Reinforcing Steel

1. Provide Grade 60 or above, deformed steel for bar reinforcement in accordance with TxDOT Standard Specifications Item 440, "Reinforcement for Concrete." Provide positioning and supporting devices (baskets and chairs) capable of securing and holding the reinforcing steel in proper position before and during paving. Provide corrosion protection when shown on the plans.

2. Provide smooth, straight dowels of the size shown on the plans, free of burrs, and conforming to the requirements of TxDOT Standard Specifications Item 440, "Reinforcement for Concrete." Coat dowels with a thin film of grease, wax, silicone or other approved de-bonding material. Provide dowel caps on the lubricated end of each dowel bar used in an expansion joint. Provide dowel caps filled with a soft compressible material with enough range of movement to allow complete closure of the expansion joint.

3. Provide straight deformed steel tie bars. Provide either multiple-piece tie bars or single-piece tie bars as shown on the plans. Furnish multiple piece tie bar assemblies from the list of approved multiple-piece tie bars that have been prequalified in accordance with DMS-4515, "Multiple Piece Tie Bars for Concrete Pavements," when used. Multiple-piece tie bars used on individual projects must be sampled in accordance with Tex-711-I, and tested in accordance with DMS-4515 "Multiple Piece Tie Bars for Concrete Pavements."

C. Alternate Reinforcing Materials

1. Provide reinforcement materials of the dimensions and with the physical properties specified when allowed or required by the plans. Provide manufacturer's certification of required material properties.

D. Curing Materials

1. Provide Type 2 membrane curing compound conforming to DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants." Provide SS-1 emulsified asphalt conforming to TxDOT Standard Specifications, Item 300, "Asphalts, Oils, and Emulsions," for concrete pavement to be overlaid with asphalt concrete under this Contract unless otherwise shown on the plans or approved. Provide materials for other methods of curing conforming to the requirements of Item 422, "Concrete Superstructures." Provide insulating blankets for curing fast track concrete pavement with a minimum thermal resistance (R) rating of 0.5 hour-square foot F/BTU. Use insulating blankets that are free from tears and are in good condition.

E. Epoxy

1. Provide Type III, Class C epoxy in accordance with DMS-6100, "Epoxies and Adhesives," for installing all drilled-in reinforcing steel. Submit a work plan and request approval for the use of epoxy types other than Type III, Class C.

F. Evaporation Retardant

1. Provide evaporation retardant conforming to DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants."

G. Joint Sealants and Fillers

1. Provide Class 5 or Class 8 joint-sealant materials and fillers unless otherwise shown on the plans or approved and other sealant materials of the size, shape, and type shown on the plans in accordance with DMS-6310, "Joint Sealants and Fillers."

PART 3 - EXECUTION

3.1 EQUIPMENT

A. Furnish and maintain all equipment in good working condition. Use measuring, mixing, and delivery equipment conforming to the requirements of TxDOT Standard Specifications, Item 421, "Hydraulic Cement Concrete." Obtain approval for other equipment used.

B. Placing, Consolidating, and Finishing Equipment.

1. Provide approved self-propelled paving equipment that uniformly distributes the concrete with minimal segregation and provides a smooth machine-finished consolidated concrete pavement conforming to plan line and grade. Provide an approved automatic grade control system on slip-forming equipment. Provide approved mechanically-operated finishing floats capable of producing a uniformly smooth pavement surface. Provide equipment capable of providing a fine, light water fog mist.

2. When string-less paving equipment is used, use "Method C," and establish control points at maximum intervals of 500 ft. Use these control points as reference to perform the work.

3. Provide mechanically-operated vibratory equipment capable of adequately consolidating the concrete. Provide immersion vibrators on the paving equipment at sufficiently close intervals to provide uniform vibration and consolidation of the concrete over the entire width and depth of the pavement and in accordance with the manufacturer's recommendations. Provide immersion vibrator units that operate at a frequency in air of at least 8,000 cycles per minute. Provide enough hand-operated immersion vibrators for timely and proper consolidation of the concrete along forms, at all joints and in areas not covered by other vibratory equipment. Surface vibrators may be used to supplement equipment-mounted immersion vibrators. Provide tachometers to verify the proper operation of all vibrators.

4. For small or irregular areas or when approved, the paving equipment described in this Section is not required.

C. Forming Equipment.

1. Pavement Forms.

a. Provide metal side forms of sufficient cross-section, strength, and rigidity to support the paving equipment and resist the impact and vibration of the operation without visible springing or settlement. Use forms that are free from detrimental kinks, bends, or warps that could affect ride quality or alignment. Provide flexible or curved metal or wood forms for curves of 100-ft. radius or less.

2. Curb Forms.

a. Provide curb forms for separately placed curbs that are not slipformed that conform to the requirements of TxDOT Standard Specifications Item 529, "Concrete Curb, Gutter, and Combined Curb and Gutter."

D. Reinforcing Steel Inserting Equipment.

1. Provide inserting equipment that accurately inserts and positions reinforcing steel in the plastic concrete parallel to the profile grade and horizontal alignment in accordance to plan details when approved.

E. Texturing Equipment

1. Carpet Drag.

a. Provide a carpet drag mounted on a work bridge or a manual moveable support system. Provide a single piece of carpet of sufficient transverse length to span the full width of the pavement being placed and adjustable so that a sufficient longitudinal length of carpet is in contact with the concrete being placed to produce the desired texture. Obtain approval to vary the length and width of the carpet to accommodate specific applications.

2. Tining Equipment

a. Provide a self-propelled metal tine device equipped with steel tines with cross-section approximately 1/32 in. thick × 1/12 in. wide. Provide tines for transverse tining equipment spaced at approximately 1 in., center-to-center, or provide tines for longitudinal tining equipment spaced at approximately 3/4 in., center-to-center. Manual methods that produce an equivalent texture may be used when it is impractical to use self-propelled equipment, such as for small areas, narrow width sections, and in emergencies due to equipment breakdown.

F. Curing Equipment

1. Provide a self-propelled machine for applying membrane curing compound using mechanically-pressurized spraying equipment with atomizing nozzles. Provide equipment and controls that maintain the required uniform rate of application over the entire paving area. Provide curing equipment that is independent of all other equipment when required to meet the requirements of "Curing." Hand-operated pressurized spraying equipment with atomizing nozzles may only be used on small or irregular areas, narrow width sections, or in emergencies due to equipment breakdown.

G. Sawing Equipment

1. Provide power-driven concrete saws to saw the joints shown on the plans. Provide standby power-driven concrete saws during concrete sawing operations.

H. Grinding Equipment

1. Provide self-propelled powered grinding equipment that is specifically designed to smooth and texture concrete pavement using circular diamond blades when required. Provide equipment with automatic grade control capable of grinding at least a 3-ft. width longitudinally in each pass without damaging the concrete.

I. Testing Equipment

1. Provide testing equipment regardless of job-control testing responsibilities in accordance with TxDOT Standard Specifications Item 421, "Hydraulic Cement Concrete," unless otherwise shown on the plans or specified.

J. Coring Equipment

1. Provide coring equipment capable of extracting cores in accordance with the requirements of Tex-424-A when required.

K. Miscellaneous Equipment

1. Furnish both 10-ft. and 15-ft. steel or magnesium long-handled, standard straightedges. Furnish enough work bridges, long enough to span the pavement, for finishing and inspection operations.

3.2 CONSTRUCTION

A. Obtain approval for adjustments to plan grade-line to maintain thickness over minor subgrade or base high spots while maintaining clearances and drainage. Maintain subgrade or base in a smooth, clean, compacted condition in conformity with the required section and established grade until the pavement concrete is placed. Keep subgrade or base damp with water before placing pavement concrete.

B. Adequately light the active work areas for all nighttime operations. Provide and maintain tools and materials to perform testing.

C. Paving and Quality Control Plan

1. Submit a paving and quality control plan for approval before beginning pavement construction operations. Include details of all operations in the concrete paving process, including methods to construct transverse joints, methods to consolidate concrete at joints, longitudinal construction joint layout, sequencing, curing, lighting, early opening, leave-outs, sawing, inspection, testing, construction methods, other details and description of all equipment. List certified personnel performing the testing. Submit revisions to the paving and quality control plan for approval.

D. Job-Control Testing

1. Perform all fresh and hardened concrete job-control testing at the specified frequency unless otherwise shown on the plans. Provide job-control testing personnel meeting the requirements of TxDOT Standard Specifications Item 421, "Hydraulic Cement Concrete." Provide and maintain testing equipment, including strength testing equipment at a location acceptable to the Engineer. Use of a commercial laboratory is acceptable. Maintain all testing equipment calibrated in accordance with pertinent test methods. Make strength-testing equipment available to the Engineer for verification testing.

2. Provide the Engineer the opportunity to witness all tests. The Engineer may require a retest if not given the opportunity to witness. Furnish a copy of all test results to the Engineer daily. Check the first few concrete loads for slump and temperature to verify concrete conformance and consistency on start-up production days. Sample and prepare strength-test specimens (2 specimens per test) on the first day of production and for each 3,000 sq. yd. or

fraction thereof of concrete pavement thereafter. Prepare at least 1 set of strength-test specimens for each production day. Perform slump and temperature tests each time strength specimens are made. Monitor concrete temperature to ensure that concrete is consistently within the temperature requirements. The Engineer will direct random job-control sampling and testing. Immediately investigate and take corrective action as approved if any Contractor test result, including tests performed for verification purposes, does not meet specification requirements.

3. The Engineer will perform job-control testing when the testing by the Contractor is waived by the plans; however, this does not waive the Contractor's responsibility for providing materials and work in accordance with this Item.

E. Job-Control Strength

1. Use 7-day job-control concrete strength testing in accordance with Tex-448-A or Tex-418-A unless otherwise shown on the plans or permitted.

2. Use a compressive strength of 3,200 psi or a lower job-control strength value proven to meet a 28-day compressive strength of 4,000 psi as correlated in accordance with Tex-427-A for 7-day job-control by compressive strength. Use a flexural strength of 450 psi or a lower job-control strength value proven to meet a 28-day flexural strength of 570 psi as correlated in accordance with Tex-427-A for 7-day job-control by flexural strength.

3. Job control of concrete strength may be correlated to an age other than 7 days in accordance with Tex-427-A when approved. Job-control strength of Class HES concrete is based on the required strength and time.

4. Investigate the strength test procedures, the quality of materials, the concrete production operations, and other possible problem areas to determine the cause when a job-control concrete strength test value is more than 10% below the required job-control strength or when 3 consecutive job-control strength values fall below the required job-control strength. Take necessary action to correct the problem, including redesign of the concrete mix if needed. The Engineer may suspend concrete paving if the Contractor is unable to identify, document, and correct the cause of low-strength test values in a timely manner. The Engineer will evaluate the structural adequacy of the pavements if any job-control strength is more than 15% below the required job-control strength. Remove and replace pavements found to be structurally inadequate at no additional cost when directed.

F. Split-Sample Verification Testing

1. Perform split-sample verification testing with the Engineer on random samples taken and split by the Engineer at a rate of at least 1 for every 10 job-control samples. The Engineer will evaluate the results of split-sample verification testing. Immediately investigate and take corrective action as approved when results of split-sample verification testing differ more than the allowable differences shown in Table 1, or the average of 10 job-control strength results and the Engineer's split-sample strength result differ by more than 10%.

Table 1

Verification Testing Limits

Test Method	Allowable Differences
Temperature, Tex-422-A	2°F
Flexural strength, Tex-448-A	19%
Compressive strength, Tex-418-A	10%

G. Reinforcing Steel and Joint Assemblies

1. Accurately place and secure in position all reinforcing steel as shown on the plans. Place dowels at mid-depth of the pavement slab, parallel to the surface. Place dowels for transverse contraction joints parallel to the pavement edge. Tolerances for location and alignment of dowels will be shown on the plans. Stagger the lap locations so that no more than 1/3 of the longitudinal steel is spliced in any given 12-ft. width and 2-ft. length of the pavement. Use multiple-piece tie bars, drill and epoxy grout tie bars, or, if approved, mechanically-inserted single-piece tie bars at longitudinal construction joints. Verify that tie bars that are drilled and epoxied or mechanically inserted into concrete at longitudinal construction joints develop a pullout resistance equal to a minimum of 3/4 of the yield strength of the steel after 7 days. Test 15 bars using ASTM E488, except that alternate approved equipment may be used. All 15 tested bars must meet the required pullout strength. Perform corrective measures to provide equivalent pullout resistance if any of the test results do not meet the required minimum pullout strength. Repair damage from testing. Acceptable corrective measures include but are not limited to installation of additional or longer tie bars.

2. Manual Placement

   a. Secure reinforcing bars at alternate intersections with wire ties or locking support chairs. Tie all splices with wire.

3. Mechanical Placement

   a. Complete the work using manual placement methods described above if mechanical placement of reinforcement results in steel misalignment or improper location, poor concrete consolidation, or other inadequacies.

H. Joints

1. Install joints as shown on the plans. Joint sealants are not required on concrete pavement that is to be overlaid with asphaltic materials. Clean and seal joints in accordance with TxDOT Standard Specifications Item 438, “Cleaning and Sealing Joints.” Repair excessive spalling of the joint saw groove using an approved method before installing the sealant. Seal all

joints before opening the pavement to all traffic. Install a rigid transverse bulkhead, for the reinforcing steel, and shaped accurately to the cross-section of the pavement when placing of concrete is stopped.

2. Placing Reinforcement at Joints

    a. Complete and place the assembly of parts at pavement joints at the required location and elevation, with all parts rigidly secured in the required position, when shown on the plans.

3. Transverse Construction Joints

    a. Continuously Reinforced Concrete Pavement (CRCP). Install additional longitudinal reinforcement through the bulkhead when shown on the plans. Protect the reinforcing steel immediately beyond the construction joint from damage, vibration, and impact.

    b. Concrete Pavement Contraction Design (CPCD). Install and rigidly secure a complete joint assembly and bulkhead in the planned transverse contraction joint location when the placing of concrete is intentionally stopped. Install a transverse construction joint either at a planned transverse contraction joint location or mid-slab between planned transverse contraction joints when the placing of concrete is unintentionally stopped. Install tie bars of the size and spacing used in the longitudinal joints for mid-slab construction joints.

    c. Curb Joints. Provide joints in the curb of the same type and location as the adjacent pavement. Use expansion joint material of the same thickness, type, and quality required for the pavement and of the section shown for the curb. Extend expansion joints through the curb. Construct curb joints at all transverse pavement joints. Place reinforcing steel into the plastic concrete pavement for non-monolithic curbs as shown on the plans unless otherwise approved. Form or saw the weakened plane joint across the full width of concrete pavement and through the monolithic curbs. Construct curb joints in accordance with TxDOT Standard Specifications Item 529, “Concrete Curb, Gutter, and Combined Curb and Gutter.”

I. Placing and Removing Forms

1. Use clean and oiled forms. Secure forms on a base or firm subgrade that is accurately graded and that provides stable support without deflection and movement by form riding equipment. Pin every form at least at the middle and near each end. Tightly join and key form sections together to prevent relative displacement.

2. Set side forms far enough in advance of concrete placement to permit inspection. Check conformity of the grade, alignment, and stability of forms immediately before placing concrete, and make all necessary corrections. Use a straightedge or other approved method to test the top of forms to ensure that the ride quality requirements for the completed pavement will be met. Stop paving operations if forms settle or deflect more than 1/8 in. under finishing operations. Reset forms to line and grade, and refinish the concrete surface to correct grade.

3. Avoid damage to the edge of the pavement when removing forms. Repair damage resulting from form removal and honeycombed areas with a mortar mix within 24 hr. after form

removal unless otherwise approved. Clean joint face and repair honeycombed or damaged areas within 24 hr. after a bulkhead for a transverse construction joint has been removed unless otherwise approved. Promptly apply membrane curing compound to the edge of the concrete pavement when forms are removed before 72 hr. after concrete placement.

4. Forms that are not the same depth as the pavement, but are within 2 in. of that depth are permitted if the subbase is trenched or the full width and length of the form base is supported with a firm material to produce the required pavement thickness. Promptly repair the form trench after use. Use flexible or curved wood or metal forms for curves of 100-ft. radius or less.

J. Concrete Delivery

1. Clean delivery equipment as necessary to prevent accumulation of old concrete before loading fresh concrete. Use agitated delivery equipment for concrete designed to have a slump of more than 5 in. Segregated concrete is subject to rejection.

2. Begin the discharge of concrete delivered in agitated delivery equipment conforming to the requirements of TxDOT Standard Specifications Item 421, “Hydraulic Cement Concrete.” Place non-agitated concrete within 45 min. after batching. Reduce times as directed when hot weather or other conditions cause quick setting of the concrete.

K. Concrete Placement

1. Do not allow the pavement edge to deviate from the established paving line by more than 1/2 in. at any point. Place the concrete as near as possible to its final location, and minimize segregation and rehandling. Distribute concrete using shovels where hand spreading is necessary. Do not use rakes or vibrators to distribute concrete.

2. Consolidation

   a. Consolidate all concrete by approved mechanical vibrators operated on the front of the paving equipment. Use immersion-type vibrators that simultaneously consolidate the full width of the placement when machine finishing. Keep vibrators from dislodging reinforcement. Use hand-operated vibrators to consolidate concrete along forms, at all joints and in areas not accessible to the machine-mounted vibrators. Do not operate machine-mounted vibrators while the paving equipment is stationary. Vibrator operations are subject to review.

3. Curbs

   a. Conform to the requirements of TxDOT Standard Specifications Item 529, “Concrete Curb, Gutter, and Combined Curb and Gutter” where curbs are placed separately.

4. Temperature Restrictions

   a. Place concrete that is between 40°F and 95°F when measured in accordance with Tex-422-A at the time of discharge, except that concrete may be used if it was already in transit when the temperature was found to exceed the allowable maximum. Take immediate corrective action or cease concrete production when the concrete temperature exceeds 95°F.

b. Do not place concrete when the ambient temperature in the shade is below 40°F and falling unless approved. Concrete may be placed when the ambient temperature in the shade is above 35°F and rising or above 40°F. Protect the pavement with an approved insulating material capable of protecting the concrete for the specified curing period when temperatures warrant protection against freezing. Submit for approval proposed measures to protect the concrete from anticipated freezing weather for the first 72 hr. after placement. Repair or replace all concrete damaged by freezing.

L. Spreading and Finishing

1. Finish all concrete pavement with approved self-propelled equipment. Use power-driven spreaders, power-driven vibrators, power-driven strike-off, screed, or approved alternate equipment. Use the transverse finishing equipment to compact and strike-off the concrete to the required section and grade without surface voids. Use float equipment for final finishing. Use concrete with a consistency that allows completion of all finishing operations without addition of water to the surface. Use the minimal amount of water fog mist necessary to maintain a moist surface. Reduce fogging if float or straightedge operations result in excess slurry.

2. Finished Surface

   a. Perform sufficient checks with long-handled 10-ft. and 15-ft. straightedges on the plastic concrete to ensure the final surface is within the tolerances specified in Surface Test A in TxDOT Standard Specification, Item 585, “Ride Quality for Pavement Surfaces.” Check with the straightedge parallel to the centerline.

3. Maintenance of Surface Moisture

   a. Prevent surface drying of the pavement before application of the curing system by means that may include water fogging, the use of wind screens, and the use of evaporation retardants. Apply evaporation retardant at the manufacturer’s recommended rate. Reapply the evaporation retardant as needed to maintain the concrete surface in a moist condition until curing system is applied. Do not use evaporation retardant as a finishing aid. Failure to take acceptable precautions to prevent surface drying of the pavement will be cause for shutdown of pavement operations.

4. Surface Texturing

   a. Complete final texturing before the concrete has attained its initial set. Drag the carpet longitudinally along the pavement surface with the carpet contact surface area adjusted to provide a satisfactory coarsely textured surface. Prevent the carpet from getting plugged with grout. Do not perform carpet dragging operations while there is excessive bleed water.

   b. A metal-tine texture finish is required unless otherwise shown on the plans. Provide transverse tining unless otherwise shown on the plans. Immediately following the carpet drag, apply a single coat of evaporation retardant, if needed, at the rate recommended by the manufacturer. Provide the metal-tine finish immediately after the concrete surface has set enough for consistent tining. Operate the metal-tine device to obtain grooves approximately 3/16 in. deep, with a minimum depth of 1/8 in., and approximately 1/12 in. wide. Do not overlap a previously tined area. Use manual

methods to achieve similar results on ramps, small or irregular areas, and narrow width sections of pavements. Repair damage to the edge of the slab and joints immediately after texturing. Do not tine pavement that will be overlaid or that is scheduled for blanket diamond grinding or shot blasting.

c. Target a carpet drag texture of 0.04 in., as measured by Tex-436-A, when carpet drag is the only surface texture required on the plans. Ensure adequate and consistent macro-texture is achieved by applying enough weight to the carpet and by keeping the carpet from getting plugged with grout. Correct any location with a texture less than 0.03 in. by diamond grinding or shot blasting. The Engineer will determine the test locations at points located transversely to the direction of traffic in the outside wheel path.

5. Small, Irregular Area, or Narrow Width Placements

a. Use hand equipment and procedures that produce a consolidated and finished pavement section to the line and grade where machine placements and finishing of concrete pavement are not practical.

6. Emergency Procedures

a. Use hand-operated equipment for applying texture, evaporation retardant, and cure in the event of equipment breakdown.

M. Curing

1. Keep the concrete pavement surface from drying as described in "Maintenance of Surface Moisture," until the curing material has been applied. Maintain and promptly repair damage to curing materials on exposed surfaces of concrete pavement continuously for at least 3 curing days. A curing day is defined as a 24-hr. period when either the temperature taken in the shade away from artificial heat is above 50°F for at least 19 hr. or the surface temperature of the concrete is maintained above 40°F for 24 hr. Curing begins when the concrete curing system has been applied. Stop concrete paving if curing compound is not being applied promptly and maintained adequately. Other methods of curing in accordance with TxDOT Standard Specifications Item 422, "Concrete Superstructures," may be used when specified or approved.

2. Membrane Curing

a. Spray the concrete surface uniformly with 2 coats of membrane curing compound at an individual application rate of no more than 180 sq. ft. per gallon. Apply the curing compound before allowing the concrete surface to dry.

b. Manage finishing and texturing operations to ensure placement of curing compound on a moist concrete surface, relatively free of bleed water, to prevent any plastic shrinkage cracking. Time the application of curing compound to prevent plastic shrinkage cracking.

c. Maintain curing compounds in a uniformly agitated condition, free of settlement before and during application. Do not thin or dilute the curing compound.

d. Apply additional compound at the same rate of coverage to correct damage where the coating shows discontinuities or other defects or if rain falls on the newly coated surface before the film has dried enough to resist damage. Ensure that the curing compound coats the sides of the tining grooves.

3. Asphalt Curing

a. Apply a uniform coating of asphalt curing at a rate of 90 to 180 sq. ft. per gallon when an asphaltic concrete overlay is required. Apply curing immediately after texturing and once the free moisture (sheen) has disappeared. Obtain approval to add water to the emulsion to improve spray distribution. Maintain the asphalt application rate when using diluted emulsions. Maintain the emulsion in a mixed condition during application.

4. Curing Class HES Concrete

a. Provide membrane curing in accordance with "Membrane Curing," for all Class HES concrete pavement. Promptly follow by wet mat curing, "Final Curing," until opening strength is achieved but not less than 24 hr.

5. Curing Fast-Track Concrete Pavement

a. Provide wet mat curing unless otherwise shown on the plans or as directed. "Final Curing." Apply a Type 1-D or Type 2 membrane cure instead of wet mat curing if the air temperature is below 65°F and insulating blankets are used.

N. Sawing Joints

1. Saw joints to the depth shown on the plans as soon as sawing can be accomplished without damage to the pavement regardless of time of day or weather conditions. Some minor raveling of the saw-cut is acceptable. Use a chalk line, string line, sawing template, or other approved method to provide a true joint alignment. Provide enough saws to match the paving production rate to ensure sawing completion at the earliest possible time to avoid uncontrolled cracking. Reduce paving production if necessary to ensure timely sawing of joints. Promptly restore membrane cure damaged within the first 72 hr. of curing.

O. Protection of Pavement and Opening to Traffic

1. Testing for early opening is the responsibility of the Contractor regardless of job-control testing responsibilities unless otherwise shown on the plans or as directed. Testing result interpretation for opening to traffic is subject to approval.

2. Protection of Pavement

a. Erect and maintain barricades and other standard and approved devices that will exclude all vehicles and equipment from the newly placed pavement for the periods specified. Protect the pavement from damage due to crossings using approved methods before opening to traffic. Where a detour is not readily available or economically feasible, an occasional crossing of the roadway with overweight equipment may be permitted for relocating equipment only but not for hauling material. When an occasional crossing of overweight equipment is permitted, temporary matting or other approved methods may be required.

b. Maintain an adequate supply of sheeting or other material to cover and protect fresh concrete surface from weather damage. Apply as needed to protect the pavement surface from weather.

3. Opening Pavement to All Traffic

a. Pavement that is 7 days old may be opened to all traffic. Clean pavement, place stable material against the pavement edges, seal joints, and perform all other traffic safety related work before opening to traffic.

4. Opening Pavement to Construction Equipment

a. Unless otherwise shown on the plans, concrete pavement may be opened early to concrete paving equipment and related delivery equipment after the concrete is at least 48 hr. old and opening strength has been demonstrated in accordance with "Early Opening to All Traffic," before curing is complete. Keep delivery equipment at least 2 ft. from the edge of the concrete pavement. Keep tracks of the paving equipment at least 1 ft. from the pavement edge. Protect textured surfaces from the paving equipment. Restore damaged membrane curing as soon as possible. Repair pavement damaged by paving or delivery equipment before opening to all traffic.

5. Early Opening to All Traffic

a. Concrete pavement may be opened after curing is complete and the concrete has attained a flexural strength of 450 psi or a compressive strength of 3,200 psi, except that pavement using Class HES concrete may be opened after 24 hr. if the specified strength is achieved.

b. Strength Testing. Test concrete specimens cured under the same conditions as the portion of the pavement involved.

c. Maturity Method

i. Use the maturity method, Tex-426-A, to estimate concrete strength for early opening pavement to traffic unless otherwise shown on the plans. Install at least 2 maturity sensors for each day's placement in areas where the maturity method will be used for early opening. Maturity sensors, when used, will be installed near the day's final placement for areas being evaluated for early opening. Use test specimens to verify the strength–maturity relationship in accordance with Tex-426-A, starting with the first day's placement corresponding to the early opening pavement section.

ii. Verify the strength–maturity relationship at least every 10 days of production after the first day. Establish a new strength–maturity relationship when the strength specimens deviate more than 10% from the maturity-estimated strengths. Suspend use of the maturity method for opening pavements to traffic when the strength–maturity relationship deviates by more than 10% until a new strength–maturity relationship is established.

iii. The Engineer will determine the frequency of verification when the maturity method is used intermittently or for only specific areas.

6. Fast Track Concrete Pavement

    a. Open the pavement after the concrete has been cured for at least 8 hr. and attained a minimum compressive strength of 1,800 psi or a minimum flexural strength of 255 psi when tested in accordance with "Strength Testing," or "Maturity Method," unless otherwise directed. Cover the pavement with insulating blankets when the air temperature is below 65°F until the pavement is opened to traffic.

7. Emergency Opening to Traffic

    a. Open the pavement to traffic under emergency conditions, when the pavement is at least 72 hr. old when directed in writing. Remove all obstructing materials, place stable material against the pavement edges, and perform other work involved in providing for the safety of traffic as required for emergency opening.

P. Pavement Thickness

1. The Contractor will be responsible for having the thickness checked in accordance with Tex-423-A unless other methods are shown on the plans. The contractor or consultant will perform 1 thickness test consisting of 1 reading at approximately the center of the paving equipment every 500 ft. or fraction thereof. Core where directed, in accordance with Tex-424-A, to verify deficiencies of more than 0.2 in. from plan thickness and to determine the limits of deficiencies of more than 0.75 in. from plan thickness. Fill core holes using an approved concrete mixture and method.

2. Thickness Deficiencies Greater than 0.2 in.

    a. Take one 4-in. diameter core at that location to verify the measurement when any depth test measured in accordance with Tex-423-A is deficient by more than 0.2 in. from the plan thickness.

    b. Take 2 additional cores from the unit as defined in "Pavement Units for Payment Adjustment" at intervals of at least 150 ft. and at selected locations if the core is deficient by more than 0.2 in., but not by more than 0.75 in. from the plan thickness, and determine the thickness of the unit for payment purposes by averaging the length of the 3 cores. In calculations of the average thickness of this unit of pavement, measurements in excess of the specified thickness by more than 0.2 in. will be considered as the specified thickness plus 0.2 in.

3. Thickness Deficiencies Greater than 0.75 in

    a. Take additional cores at 10-ft. intervals in each direction parallel to the centerline to determine the boundary of the deficient area if a core is deficient by more than 0.75 in. The Engineer will evaluate any area of pavement found deficient in thickness by more than 0.75 in., but not more than 1 in. Remove and replace the deficient areas without additional compensation or retain deficient areas without compensation, as directed. Remove and replace any area of pavement found deficient in thickness by more than 1 in. without additional compensation.

4. Pavement Units for Payment Adjustment

a. Limits for applying a payment adjustment for deficient pavement thickness from 0.20 in. to not more than 0.75 in. are 500 ft. of pavement in each lane. Lane width will be as shown on typical sections and pavement design standards.

b. For greater than 0.75 in. deficient thickness, the limits for applying zero payment or requiring removal will be defined by coring or equivalent nondestructive means as determined by the Engineer. The remaining portion of the unit determined to be less than 0.75 in. deficient will be subject to the payment adjustment based on the average core thickness at each end of the 10-ft. interval investigation as determined by the Engineer.

c. Shoulders will be measured for thickness unless otherwise shown on the plans. Shoulders 6 ft. wide or wider will be considered as lanes. Shoulders less than 6 ft. wide will be considered part of the adjacent lane.

d. Limits for applying payment adjustment for deficient pavement thickness for ramps, widenings, acceleration and deceleration lanes, and other miscellaneous areas are 500 ft. in length. Areas less than 500 ft. in length will be individually evaluated for payment adjustment based on the plan area.

Q. Ride Quality

1. Measure ride quality in accordance with TxDOT Standard Specifications Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

3.3 MEASUREMENT

A. This Item will be measured as follows:

1. Concrete Pavement

a. Concrete pavement will be measured by the square yard of surface area in place. The surface area includes the portion of the pavement slab extending beneath the curb.

2. Curb

a. Curb on concrete pavement will be measured by the foot in place.

3.4 PAYMENT

A. These prices are full compensation for materials, equipment, labor, tools, and incidentals.

B. Concrete Pavement

1. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the adjusted unit price bid for "Concrete Pavement" of the type and depth specified as adjusted in accordance with "Deficient Thickness Adjustment."

C. Deficient Thickness Adjustment

1. Where the average thickness of pavement is deficient in thickness by more than 0.2 in. but not more than 0.75 in., payment will be made using the adjustment factor as specified in Table 2 applied to the bid price for the deficient area for each unit as defined under "Pavement Units for Payment Adjustment."

Table 2

Deficient Thickness Price Adjustment Factor

Deficiency in Thickness Determined by Cores (in.)	Proportional Part of Contract Price Allowed (Adjustment Factor)
Not deficient	1.00
Over 0.00 through 0.20	1.00
Over 0.20 through 0.30	0.80
Over 0.30 through 0.40	0.72
Over 0.40 through 0.50	0.68
Over 0.50 through 0.75	0.57

D. Curb

1. Work performed and furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Curb" of the type specified.

END OF SECTION

SECTION 32 13 73

EXPANSION JOINT MATERIALS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item shall govern for the furnishing and placing of all expansion joint material as herein specified in the various items of these specifications or as shown on the plans.

PART 2 – PRODUCTS

2.1 MATERIAL

A. The material used for expansion joints shall conform to the following:

B. Preformed Bituminous Fiber Material shall be formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly impregnated with a suitable asphaltic binder and shall meet the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, A.S.T.M. Designation D-1751.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. All materials used shall extend the full depth of the concrete and shall be perpendicular to the exposed face. All joints shall be shaped to conform to the contour of the finished section in which they are installed. All material shall be a minimum of one-half inch (1/2") thick unless otherwise detailed on plans.

END OF SECTION

SECTION 32 1425

GRAVEL

PART 1 - GENERAL

1.01 Related Documents

A. Drawings and general provisions of contract, including general and supplementary conditions and all applicable specification sections, apply to this section.

1.02 Scope

A. Provide labor, materials, equipment and appliances necessary to install and complete gravel bed in accordance with contract documents.

B. Work shall include, but not necessarily be limited to, compaction of subgrade and installation of non woven geotextile fabric.

1.03 Quality Assurance

A. The Contractor is responsible for correction of work which does not conform to the specified requirements, including colors and sizes. Correct deficient materials as directed by the owner.

PART 2 - MATERIALS

A. Gravel type shall be 'Golden Brown' and Sierra Red' decorative gravel ¾" diameter typical and shall be clean from all foreign materials; from Desert Rock Co., 8500 Plant Road, El Paso, TX 79907 or equal.

B. Stone type shall be 'Trail Mix' decorative gravel 2'6" diameter typical and shall be clean from all foreign materials; from Desert Rock Co., 8500 Plant Road, El Paso, TX 79907 or equal.

C. Geotextile fabric -shall be Contech C-60NW Nonwoven Geotextile or approved equal. Material shall be made of polypropylene, stable fiber, needle punched nonwoven, with permeability or water flow rate at 120 gallons minimum per square foot.

2.01 Submittals

A. Contractor shall provide samples of gravel in small bags for approval.

B. Filter fabric manufacturer's product data.

2.02 Product Handling

A. Material shall only be delivered and stockpiled at job site at a location agreed upon with the landscape architect and owner when the site is ready for installation.

2.03 Delivery And Storage

A. Promptly notify the owner's representative in advance of the time of delivery of the gravel material.

PART 3 – EXECUTION

3.01 General

A. Review the site and related drawings for ground areas to receive gravel work and obtain approval of the owner's representative before work is begun.

B. In order to minimize conflict, locate all existing utilities and drainage pipes prior to beginning work.

3.02 Installation

A. Inspect finished grades as it shall be level and true to line. Installation shall be properly coincide and align with adjacent work and elevations. All edges must be retained as per details.

B. Install geotextile fabric with all edges properly secured to the ground to prevent fabrics from flipping and exposing finish grade that causes erosion.

C. Install gravel to specified depth.

END OF SECTION

SECTION 32 16 13

CURBS AND GUTTERS

PART 1 – GENERAL

1.1 DESCRITPION

A. Construct hydraulic cement concrete curb, gutter, and combined curb and gutter.

PART 2 – PRODUCTS

2.1 MATERIALS

A. GENERAL

1. Furnish materials conforming to:
    a. Section 03 11 00 “Civil Concrete Formwork”
    b. Section 03 20 00 “Civil Concrete Reinforcement”
    c. Section 32 13 13 “Concrete Pavement”
    d. TxDOT Standard Specifications, Item 420, “Concrete Substructures”
2. Use Class A concrete or material specified on the plans. Use Grade 8 coarse aggregate for extruded Class A concrete. Use other grades if approved.
3. When approved, use fibers meeting the requirements of DMS-4550, “Fibers for Concrete,” to replace reinforcing steel in Class A concrete. Dose fibers in accordance with the Department’s MPL of pre-qualified fibers for concrete.

PART 3 – EXECUTION

3.1 CONSTRUCTION

A. GENERAL

1. This Provide finished work with a well-compacted mass and a surface free from voids and honeycomb, in the required shape, line, and grade. Round exposed edges with an edging tool of the radius shown on the plans. Mix, place, and cure concrete in accordance with TxDOT Standard Specifications Item 420, “Concrete Substructures.” Construct joints at locations shown on the plans. Cure for at least 72 hr.
2. Furnish and place reinforcing steel in accordance with Division 31, Item 2000 “Civil Concrete Reinforcement”.
3. Set and maintain a guideline that conforms to alignment data shown on the plans, with an outline that conforms to the details shown on the plans. Ensure that changes in curb grade and alignment do not exceed 1/4 in. between any 2 contacts on a 10-ft. straightedge.

B. Conventionally Formed Concrete.

1. Shape and compact subgrade, foundation, or pavement surface to the line, grade, and cross-section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement.
2. Pour concrete into forms, and strike off with a template 1/4 to 3/8 in. less than the dimensions of the finished curb unless otherwise approved. After initial set, plaster surface with mortar consisting of 1 part hydraulic cement and 2 parts fine aggregate. Brush exposed surfaces to a uniform texture.
3. Place curbs, gutters, and combined curb and gutters in 50 ft. maximum sections unless otherwise approved.

C. Extruded or Slipformed Concrete.

1. Hand-tamp and sprinkle subgrade or foundation material before concrete placement. Provide clean surfaces for concrete placement. Coat cleaned surfaces, if required, with approved adhesive or coating at the rate of application shown on the plans or as directed. Place concrete with approved self-propelled equipment.
2. The forming tube of the extrusion machine or the form of the slipform machine must be easily adjustable vertically during the forward motion of the machine to provide variable heights necessary to conform to the established gradeline.
3. Attach a pointer or gauge to the machine so that a continual comparison can be made between the extruded or slipform work and the grade guideline. Other methods may be used when approved.
4. Finish surfaces immediately after extrusion or slipforming.

3.2 MEASUREMENT

A. This Item will be measured by the foot.

3.3 PAYMENT

A. 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 “Concrete Curb,” “Concrete Curb (Mono),” or “Concrete Curb and Gutter” of the type specified. This price is full compensation for surface preparation of curb foundation, equipment, labor, materials, tools, and incidentals.

END OF SECTION

SECTION 32 16 23

SIDEWALKS

PART 1 – GENERAL

1.1 DESCRITPION

A. Construct hydraulic cement concrete sidewalks.

PART 2 – PRODUCTS

2.1 MATERIALS

A. This Item Furnish materials conforming to the following:

1. Section 03 20 00 “Concrete Reinforcement”
2. Section 32 13 13 “Concrete Pavement”
3. TxDOT Standard Specifications Item 421, “Hydraulic Cement Concrete”

B. Use Class A concrete unless otherwise shown on the plans. Use Grade 8 course aggregate for extruded Class A concrete. Use other grades if approved.

PART 3 – EXECUTION

3.1 CONSTRUCTION

A. GENERAL NOTES

1. Shape and compact subgrade, foundation, or pavement surface to the line, grade, and cross-section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement. Hand-tamp and sprinkle foundation when placement is directly on subgrade or foundation materials. Remove and dispose of existing concrete in accordance with TxDOT Standard Specifications Item 104, “Removing Concrete.” Provide a clean surface for concrete placement directly on the surface material or pavement.
2. Mix and place concrete in accordance with the pertinent Items. Hand-finishing is allowed for any method of construction. Finish exposed surfaces to a uniform transverse broom finish surface. Curb ramps must include a detectable warning surface and conform to details shown on the plans. Install joints as shown on the plans. Ensure that abrupt changes in sidewalk elevation do not exceed 1/4 in., sidewalk cross slope does not exceed 2%, curb ramp grade does not exceed 8.3%, and flares adjacent to the ramp do not exceed 10% slope. Ensure that the sidewalk depth and reinforcement are not less than the driveway cross-sectional details shown on the plans where a sidewalk crosses a concrete driveway.
3. Provide finished work with a well-compacted mass, a surface free from voids and honeycomb, and the required true-to-line shape and grade. Cure for at least 72 hr. in accordance with TxDOT Standard Specifications Item 420, “Concrete Substructures.”

B. Conventionally Formed Concrete. Provide pre-molded or board expansion joints of the thickness shown on the plans for sidewalk section lengths greater than 8 ft. but less than 40 ft., unless otherwise directed. Terminate workday production at an expansion joint.

C. Extruded or Slipformed Concrete. Provide any additional surface finishing immediately after extrusion or slipforming as required on the plans. Construct joints at locations as shown on the

plans or as directed.

3.2 MEASUREMENT

A. Sidewalks will be measured by the square yard of surface area. Curb ramps will be measured by the square yard of surface area or by each. A curb ramp consists of the ramp, landing, adjacent flares or side curb, and detectable warning surface as shown on the plans.

3.3 PAYMENT

A. 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 “Concrete Sidewalks” of the depth specified and “Curb Ramps” of the type specified. This price is full compensation for surface preparation of sidewalk foundation; materials; removal and disposal of existing concrete; excavation, hauling and disposal of excavated material; drilling and doweling into existing concrete curb, sidewalk, and pavement; repair of adjacent street or pavement structure damaged by these operations; and equipment, labor, materials, tools, and incidentals.

B. Sidewalks that cross and connect to concrete driveways or turnouts will be measured and paid for in accordance with this section.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCE

PART 1 - GENERAL

1.1 DESCRITPION

A. Furnish, install, remove, repair, or replace chain link fence and gates.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Furnish certification from the chain link fence materials manufacturer stating that all fencing materials comply with the requirements of this Item before installation of the fence. Use only new materials.

B. General.

1. Furnish materials in accordance with the following:
    a. TxDOT Standard Specifications Item 421, “Hydraulic Cement Concrete,” Class B
    b. TxDOT Standard Specifications Item 445, “Galvanizing”

C. Wire Fabric.

1. Provide wire fabric with:
    a. 9 gauge (0.148 in. diameter) steel wire with a minimum breaking strength of 1,290 lb. meeting ASTM A392 Class I or ASTM A491;
    b. mesh size of 2 in. ±1/8 in. between parallel wires with at least 7 meshes in a vertical dimension of 23 in. along the diagonals of the openings; and
    c. knuckled selvages at the top and bottom edge of the fabric, unless otherwise shown on the plans.

D. Posts.

1. Provide posts of the size and weight shown on the plans. Do not provide rerolled or open-seam posts. Use material for all posts meeting ASTM F1043 Group 1A Regular Grade or Group 1C High Strength.

E. Post Caps.

1. Provide malleable iron post caps designed to exclude all moisture. Furnish barbed wire support arms integral with the post caps if barbed wire is shown on the plans. Furnish post caps with an opening for the top rail if top rail is shown on the plans. Post caps must have a 2-in. skirt.

F. Gates.

1. Provide gates fabricated from round sections of pipe of the size and weight shown on the plans. Use material for all gate pipes meeting ASTM F1043 Group 1A Regular Grade or Group 1C High Strength. For each gate, include:
    a. corner and tee fittings of malleable iron or pressed steel with means for attaching diagonal bracing members;
    b. hinges of malleable iron allowing a full 180° swing, easily operated by one person;
    c. ball-and-socket-type bottom hinges that do not twist or turn from the action of the gate and prevent the closed gate from being lifted off the hinges;
    d. a positive stop that prevents any portion of the gate from swinging over an adjacent traffic lane;
    e. malleable iron pulley systems for roll type gate (only when required);
    f. diagonal braces consisting of 3/8-in. diameter cable with turnbuckles, 2 to each gate frame, and, for vehicle gates, a vertical pipe brace of the size and weight shown on the plans at the center of each gate leaf;

g. latches of malleable iron or steel for single gates with a single-fork latch and padlock eye that will keep the gate closed;
h. 2 fork latches mounted on a center plunger rod with a padlock eye for double-leaf gates;
i. holdbacks for each leaf of vehicular gates, with a semi-automatic holdback catch anchored at least 12 in. into a 12-in. diameter by 24-in. deep concrete footing; and
j. a malleable iron center rest, designed to receive the plunger rod anchored as shown on the plans for all double-leaf gates.

G. Top Rail.
1. Use material meeting ASTM F1043 Group 1A or 1C for all top rail pipes. Provide 1.660 in. OD top rail manufactured from Group 1A standard weight (Schedule 40) steel pipe weighing 2.27 lb. per foot or from Group 1C high-strength pipe weighing 1.84 lb. per foot when shown on the plans. Provide pipe in sections at least 18 ft. long joined with outside steel sleeve couplings at least 6 in. long with a minimum wall thickness of 0.70 in. Use couplings designed to allow for expansion of the top rail.

H. Tension Wire.
1. Use 7 gauge (0.177-in.) carbon steel wire with a minimum breaking strength of 1,950 lb. for the bottom edge of all fence fabric, and for the top edge of fence fabric when a top rail is not specified.

I. Truss Bracing.
1. Provide truss bracing as shown on the plans.

J. Cables.
1. Provide 7-wire strand cables manufactured of galvanized annealed steel at least 3/8 in. in diameter.

K. Barbed Wire.
1. Provide 3 strands of twisted 12.5 gauge barbed wire with 2-point, 14 gauge barbs spaced approximately 5 in. apart conforming to ASTM A121 or ASTM A585 when specified on the plans.

L. Barbed Wire Support Arms.
1. Provide support arms at an angle of 45° from vertical, with clips for attaching 3 strands of barbed wire to each support arm and sufficient strength to support a 200-lb. weight applied at the outer strand when barbed wire is specified on the plans.

M. Stretcher Bars.
1. Provide stretcher bars made of flat steel at least 3/16 × 3/4 in. and not more than 2 in. shorter than the fabric height. Provide one stretcher bar for each gate and end post and 2 stretcher bars for each corner and pull post.

N. Grounds.
1. Provide copper-clad steel rods 8 ft. long with a minimum diameter of 5/8 in., or other UL-listed ground rods.

O. Miscellaneous Fittings and Fasteners.
1. Furnish enough fittings and fasteners to erect all fencing materials in a proper manner. Furnish fittings for posts from pressed or rolled steel, forged steel, malleable iron or wrought iron of good commercial quality spaced as shown on the plans.

P. Coatings.
1. Hot-dip galvanize all materials unless specified otherwise in this Item or on the plans. Fabric, tension wire, and barbed wire may be aluminum-coated or alloy-coated if approved. Additionally, coat all material except bolts, nuts, washers, and pipe material with thermally fused polyvinyl chloride (PVC) in accordance with ASTM F668, Class 2b, meeting the specified color when shown on the plans.
2. Fabric.
   a. Galvanizing. Hot-dip galvanize in accordance with ASTM A392, Class I.
   b. Aluminum Coating. Aluminum-coat in accordance with ASTM A491.

c. Alloy Coating. Coat with zinc-5% aluminum-mischmetal alloy (Zn-5A1-MM) in accordance with ASTM F1345, Class I.

3. Posts, Braces, and Gates.
   a. Standard Weight (Schedule 40) Pipe. Hot-dip galvanize inside and outside according to ASTM F1043 (1.8 oz./sq. ft. galvanized zinc weight).
   b. High Strength Pipe. Hot-dip galvanize before or after forming pipe according to ASTM F1043 Group 1C and as follows:
      1) Outside—minimum 0.9 oz./sq. ft. galvanized zinc weight with a verifiable polymer overcoat.
      2) Inside—minimum 0.9 oz./sq. ft. galvanized zinc weight before forming, or minimum 0.3 mils zinc-based coating after forming containing a minimum 90% zinc dust, by weight.
   c. Optional Additional Coating. Additionally, coat all pipe material with 10 mils minimum thermally fused PVC according to ASTM F1043, meeting the specified color when shown on the plans.
4. Fittings, Bolts, and Other Miscellaneous Hardware. Galvanize all fittings, bolts, and miscellaneous hardware in conformance with TxDOT Standard Specifications Item 445, "Galvanizing."
5. Tension Wire. Zinc-coat tension wire with a minimum coating of 0.80 oz./sq. ft. or aluminum-coat with a minimum coating of 0.30 oz./sq. ft.
6. Barbed Wire. Zinc-coat barbed wire in accordance with ASTM A121 (0.80 oz./sq. ft.) or aluminum-coat in accordance with ASTM A585 (0.30 oz./sq. ft.).
7. Pull Cable. Zinc-coat pull cable with a minimum coating of 0.80 oz./sq. ft. of individual-wire surface when tested in conformance with ASTM A116.

PART 3 – EXECUTION

3.1 CONSTRUCTION

A. GENERAL
   1. Erect the chain link fence to the lines and grades established on the plans. Overall height of the fence when erected is the height above the grade shown.
   2. Repair or replace damaged fence or gates. Remove and replace the post and foundation if posts cannot be repaired by straightening. Return all salvageable material to the location shown on the plans when a fence installation is to be removed in its entirety and not replaced. Backfill all postholes with suitable material. Return the salvaged fence fabric in secured rolls not more than 50 ft. long. Dispose of unsalvageable material.

B. Clearing and Grading.
   1. Clear all brush, rocks, and debris necessary for the installation of this fencing.
   2. Stake the locations for corner posts and terminal posts unless otherwise shown on the plans. Follow the finished ground elevations for fencing panels between corner and terminal posts. Level off minor irregularities in the path of the fencing.

C. Erection of Posts.
   1. Install posts as shown on the plans. Plumb and permanently position posts with anchorages firmly set before fabric is placed. Brace corner and pull posts as shown on the plans.

D. Post Spacing. Space posts as shown in Table 1.

Table 1
Post Spacing and Placement

Post Type	Required Spacing or Placement
Line posts	no more than 10 ft. apart
Pull posts	no more than 500 ft. apart and at each change in direction exceeding 20° vertically
Corner posts	at each horizontal angle point

Install cables on all terminal posts and extend to adjacent posts. Install cables on each side of corner and pull posts with a 3/8-in. drop-forged eye-and-eye or eye-and-clevis turnbuckle unless otherwise shown on the plans.

E. Postholes.
1. Drill holes for concrete footings for all posts to provide footings of the dimensions shown on the plans.
2. Penetrate solid rock by at least 12 in. (18 in. for end, corner, gate, and pull posts) or to plan depth where the rock is encountered before reaching plan depth. Drill holes in the solid rock with a diameter at least 1 in. greater than the outside diameter of the post.
3. Fill the hole in the solid rock with grout consisting of 1 part hydraulic cement and 3 parts clean, well-graded sand after the posts are set and plumbed. If desired, other grouting materials may be used only if approved. Thoroughly work the grout into the hole, leaving no voids. Construct concrete footings from the solid rock to the top of the ground.

F.Gate Posts.
1. Align the tops of all gate frames with the fencing top tension wire or top rail. Provide vehicular gates that are greater in overall height than the adjacent fencing by the height necessary to extend to within 2 in. of the pavement between the curbs if curbs are shown on the plans.

G. Concrete Footings.
1. Center posts in their footings. Place concrete and compact by tamping or other approved methods. Machine mix all batches of concrete over 1/2 cu. yd. Hand mixing concrete is allowed on batches under 1/2 cu. yd.
2. Use forms for footings where the ground cannot be satisfactorily excavated to neat lines. Crown the concrete or grout (for solid rock) to carry water from the post. Keep the forms in place for at least 24 hr. Backfill the footing with moistened material as soon as each form is removed, and thoroughly tamp. Cover concrete with at least 4 in. of loose moist material, free of clods and gravel, immediately after placing concrete. No other curing is required.
3. Spread all excess excavated and loose material used for curing neatly and uniformly. Remove excess concrete and other construction debris from the site.

H. Erection of Fabric.
1. Place the fabric with the cables drawn taut with the turnbuckles after all posts have been permanently positioned and anchorages firmly set. Secure one end and apply enough tension to the other end to remove all slack before making attachments. Cut the fabric and independently attach each span at all corner posts and pull posts unless otherwise shown on the plans.
2. Follow the finished contour of the site with the bottom edge of fabric located approximately 2 in. above the grade. Grade uneven areas so the maximum distance between the bottom of fabric and ground is 6 in. or less.
3. Fasten fabric at 12 in. intervals to the top and bottom tension wires between posts. Fasten the fabric in the same manner when top rail is shown on the plans. Fasten the fabric on gate

frames to the top and bottom of the frame at 12 in. intervals. Use steel wire fabric ties of 9 gauge steel or larger. Fasten fabric to terminal posts by steel stretcher bars and stretcher bar bands fitted with carriage bolts and nuts of the size and spacing shown on the plans. Use stretcher bars to fasten end posts, pull posts, corner posts, and gateposts with stretcher bar bands at intervals of no more than 15 in. Attach stretcher bars to terminal posts with 1 × 1/8 in. flat steel bands with 3/8-in. carriage bolts at intervals up to 15 in.

I. Electrical Grounds.
   1. Provide at least one electrical ground for each 1,000 ft. of fence, located near the center of the run. Provide additional grounds directly under the point where power lines pass over the fence.
   2. Vertically drive or drill in the grounding rod until the top of the rod is approximately 6 in. below the top of the ground. Connect a No. 6 solid copper conductor to the rod and to the fence by a UL-listed method so that each element of the fence is grounded.

J. Repair of Coatings.
   1. Repair damaged zinc coating in accordance with TxDOT Standard Specifications Item 445, Section 3.5., "Repairs."

3.2 MEASUREMENT

A. Chain link fence will be measured by the foot of fence installed, repaired, replaced, or removed, measured at the bottom of the fabric along the centerline of the fence from center to center of posts, excluding gates.

B. Gates will be measured as each gate installed, repaired, replaced, or removed.

3.3 PAYMENT

A. 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 "Chain Link Fence (Install)" or "Chain Link Fence (Repair)" of the height specified or "Chain Link Fence (Remove)" and "Gate (Install)" or "Gate (Repair)" of the type, height, and width of opening specified or "Gate (Remove)." Clearing and grading for fencing and gates will not be paid for directly but is subsidiary to this Item.
   1. Chain Link Fence (Install). This price is full compensation for furnishing and installing fencing, except gates; cleaning, grading, and backfilling; removing and disposing of surplus material; and equipment, labor, tools, and incidentals.
   2. Chain Link Fence (Repair). This price is full compensation for furnishing materials; repairing or replacing fencing, except gates; cleaning, grading, and backfilling; removing and disposing of surplus or damaged material; and equipment, labor, tools, and incidentals.
   3. Chain Link Fence (Remove). This price is full compensation for removing all fencing, except gates; cleaning, grading, and backfilling; removing and disposing of surplus material; and equipment, labor, tools, and incidentals.
   4. Gate (Install). This price is full compensation for installing gate and for providing materials, center anchorages, equipment, labor, tools, and incidentals.
   5. Gate (Repair). This price is full compensation for repairing or replacing gate and for furnishing materials; removing and disposing of damaged materials; and equipment, labor, tools, and incidentals.
   6. Gate (Remove). This price is full compensation for removing gate and for materials, equipment, labor, tools, and incidentals.

END OF SECTION

SECTION 328400

PLANTING IRRIGATION

PART 1 – GENERAL

1.01 Scope:

A. Furnish all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with the installation of underground sprinkler irrigation system complete, as shown on drawings and/or specified herein. When the term "Contractor" is used in this section, it shall refer to the Irrigation Subcontractor.

1.02 Quality Assurance:

The following Codes, Regulations, Reference Standards, and Specifications apply to work included in this section: ASTM: D2241, D2464, D2466, and D2564.

1.03 Warranty and Maintenance:

A. The Contractor shall warranty material and workmanship for one year after final acceptance including repair and replacement of defective materials, workmanship, and repair of backfill settlement.

B. Maintenance during warranty shall include, but not necessarily be limited to, the following:

1. Adjustment of sprinkler height and plumb to compensate for settlement and/or plant growth.
2. Backfilling of all trenches.
3. Adjustment of head coverage (arc of spray) as necessary.
4. Unstopping heads plugged by foreign material.
5. Adjustment of controller as necessary to insure proper sequence and watering time.
6. All maintenance necessary to keep the system in good operating order. Repair of damage caused by vandals, other contractors or weather conditions shall be considered extra to these specifications.

C. Warranty and maintenance after final acceptance does not include alterations as necessitated by re-landscaping, re-grading, addition of trees or the addition, and/or changes in sidewalks, walls, driveways, etc.

D. Maintenance shall continue for one month after final acceptance.

1.04 Submittals:

A. The Contractor shall submit shop drawings or manufacturer's "cut sheet" for each type of sprinkler head, pipe, controller, valves, check valve assemblies, valve boxes, wire, conduit, fittings, and all other types of fixtures and equipment proposed to install on the job. The submittal shall include the manufacturer's name, model number, equipment capacity, and manufacturer's installation recommendation, if applicable, for each proposed item.

B. No partial submittal will be accepted and submittals shall be submitted in pdf format and logically organized. After the submittal has been approved, substitutions will not be allowed except by written consent of the Landscape Architect.

C. Shop drawings shall include dimensions, elevations, construction, details, arrangements, and capacity of equipment, as well as manufacturer's installation recommendations.

1.05 Substitutions:

A. Items on the plans are specified by a manufacturer's brand name and catalog number, followed by the phrase "or approved equal". This is not intended to unduly restrict competitive procurements or bidding, but is to assure a minimum standard of quality which is believed to be best for the item specified and to match existing equipment.

1.06 Codes and Permits:

A. All work under this section shall comply with the provisions of these Specifications, as illustrated on the accompanying drawings, or as directed by the Owner and shall satisfy all applicable local codes, ordinances, or regulations of the governing bodies and all authorities having jurisdiction over this Project.

B. Installation of equipment and materials shall be done in accordance with requirements of the National Electrical Code, City Plumbing Code, and standard plumbing procedures. The drawings and these Specifications are intended to comply with all the necessary rules and regulations; however, some discrepancies may occur, the Contractor shall immediately notify the Landscape Architect in writing of the discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with the regulations shall be paid for as covered by these Contract documents.

C. The Contractor shall give all necessary notices, obtain all permits, and pay all costs in connection with his work; file with all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver to the Owner.

D. The Contractor shall include in the work any labor, materials, services, apparatus, or drawings in order to comply with all applicable laws, ordinances, rules, and regulations whether or not shown on the drawings and/or specified.

E. The installation of the irrigation system shall be made by an individual or firm duly licensed under Article No. 8751 VTCS, Titled "Licensed Irrigators Act", S.B. No. 259 as passed by the 66th Texas Legislature.

1.07 Existing Utilities:

A. Locations and elevations of various utilities included with the scope of this work have been obtained from the most reliable sources available and should serve as a general guide without guarantee to accuracy. The Contractor shall examine the Site and verify to his own satisfaction the locations and elevation of all utilities and availability of utilities and services required. The Contractor shall inform himself as to their relation to the work and the submission of bids shall be deemed as evidence thereof. The Contractor shall repair at his own expense, and to the satisfaction of the Owner, for damage to any utility shown or not shown on the plans.

B. Should utilities not shown on the plans be found during excavations, Contractor shall promptly notify the Owner for instructions as to further action.

C. Contractor shall make necessary adjustments in the layout as may be required to connect to existing stub-outs, should such stub- outs not be located exactly as shown and as may be required to work around existing work, at no increase in cost to the Owner. All such work will be recorded on record drawings and turned over to the Owner prior to final acceptance.

1.08 Record Drawings:

A. Record dimensioned locations and depths for each of the following:

1. Point of connection.
2. Sprinkler pressure line routing (provide dimensions for each 100 lineal feet (maximum) along each routing, and for each change in directions).
3. Gate valves.
4. Sprinkler control valves (buried only).
5. Control wire routing.
6. Other related items as may be directed by the Landscape Architect.

B. Locate all dimensions from two permanent points (buildings, monuments, sidewalks, curbs, or pavements).

C. Record all changes which are made from the Contract drawings, including changes in the pressure and non-pressure lines.

D. Record all required information on a set of reproducible drawing files.

E. Maintain information daily. Keep Contract drawings at the Worksite at all times and available for review by the Owner's representative.

1.09 Controller Charts:

A. Do not prepare charts until record drawings have been approved by the Owner's representative.

B. Provide one controller chart for each automatic controller installed.

1. Chart may be a reproduction of the record drawing, if the scale permits fitting within the controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.

2. Chart shall be blackline print of the actual system, showing the area covered by that controller.

C. Identify the area of coverage of each remote control valve, using a distinctly different pastel color, drawn over the entire area of coverage.

D. Following approval of charts by the Owner's representative, they shall be hermetically sealed between two layers of 20 mil. thick plastic sheet.

E. Charts must be completed and approved prior to final acceptance of the irrigation system.

1.10 Operation and Maintenance Manuals:

A. Provide individual bound manuals detailing operating and maintenance requirements for irrigation systems.

B. Manuals shall be delivered to the Owner's representative for review and approval no later than 10 days prior to completion of work. Revise manual as required.

C. Provide descriptions of all installed materials and systems in sufficient detail to permit maintenance personnel to understand, operate, and maintain the equipment.

D. Provide the following in each manual:

1. Index sheet, stating Irrigation Contractor's name, address, telephone number, and name of person to contact.
2. Duration of guarantee period.
3. Equipment list providing the following for each item:
    a. Manufacturer's name.
    b. Make and model number.
    c. Name and address of local manufacturer's representative.
    d. Spare parts list in detail.
    e. Detailed operating and maintenance instructions of major equipment.
4. Recommended programs for watering by season.

1.11 Checklists:

A. Provide a signed and dated checklist, and deliver to the Owner's representative prior to final acceptance of the work.

B. Use the following format:

1. Plumbing permits: if none required, so note.
2. Material approvals: approved by and date.
3. Pressure line tests: by whom and date.
4. Record Drawings: received by and date.
5. Controller charts: received by and date.
6. Materials furnished: received by and date.
7. Operation and maintenance manuals: received by and date.
8. System and equipment operation instructions: received by and date.
9. Manufacturer's warranties if required: received by and date.
10. Written guarantee: received by and date.
11. Lowering of heads in lawn areas: if incomplete, so state.

1.12 Electric Power:

Electric power shall be provided within five feet of each controller location by the General Contractor. The irrigation contractor shall provide final hardwire connection.

1.13 Water for Testing:

Unless noted otherwise on the plans or elsewhere, furnish all water necessary for testing, flushing, and jetting.

1.14 Borings, Sleeves and Conduits:

Sleeves and electrical conduits are the responsibility of the Irrigation Contractor to install prior to paving or related construction and should be installed as noted on the drawings and specifications. Contractors shall be responsible for locating all sleeves and conduits at no additional cost to the Authority. Borings under existing paving will be required where noted on the drawings and shall be provided at no additional cost to the Owner. Borings shall be a minimum of 18 inch depth and new pipes shall be incased in PVC sleeves as noted on the plans.

1.15 Spare Parts:

The Contractor shall supply the Owner with five spray heads, one for each head designated on the plan. The Contractor shall supply one additional key and hose swivel for the quick coupler.

PART 2 – MATERIALS

2.00 GENERAL:

Unless otherwise noted on the plans, all materials shall be new and unused. The irrigation equipment catalog numbers used for reference in these Specifications are to establish minimum quality standards and may be substituted with an "approved equal" as outlined in Paragraph 1.5 of this section.

2.01 Polyvinyl Chloride Pipe (PVC PIPE):

PVC pipe manufactured in accordance with ASTM Standards noted herein.

A. Marking and Identification: PVC pipe shall be continuously and permanently marked with following information: Manufacturer's name, size, type of pipe, and material, SDR number, Product Standard number, and the NSF (National Sanitation Foundation) Seal.

B. PVC pipe fittings: Shall be of the same material as the PVC pipe specified and compatible with PVC pipe furnished. Solvent weld type fittings shall be Schedule 40.

C. PVC Pipe: Shall be as noted on the plans. Sizes up to 3” diameter shall be solvent weld type. Pipe sizes of 4” diameter and larger shall be o-ring gasket type with ductile iron gasket fittings.

D. Pipe sleeves: Shall be as noted on the plans.

2.03 Swing Joints:

Swing joints shall be O-ring seal type, Lasco or approved equal.

2.04 Wire and Splices:

A. Valve wire shall be as noted on the plans, minimum 14 gauge with type UF insulation which is Underwriters Laboratory approved for direct underground burial when used in a National Electrical Code Class II Circuit (30 volts AC or less) as per Articles 725 and 300. Voltage drop shall be taken into consideration.

B. All connectors shall be UL listed, rated 600 volt, for PVC insulated wire. No wire splices shall be buried.

2.05 Quick-Couple Valves:

A. Quick coupling valves shall be composed of a bronze cast body with a purple, (NP) cover.

B. The valve shall accept a single lug 3/4 inch bronze valve key for operation unless noted otherwise.

2.06 Manual Valves:

A. Unless noted otherwise, manual valves 2-1/2 inches and smaller shall be all brass, globe type with composition disc rated at 150 pounds W.O.G. Manual valve size 4" and larger shall be Kennedy cast iron type.

B. All valves shall have wheel handles unless cross handles are called for on the plan.

2.07 Valve Boxes:

A. A box shall be provided for all valves.

B. Valve boxes shall be made of high-strength plastic suitable for turf irrigation purposes.

C. Boxes shall be suitable in size and configuration for the operability and adjustment of the valve.

D. Extension sections will be used as appropriate to the depth of piping.

E. All valve box covers shall bolt down or have locking mechanisms and shall be colored green or black as selected by the Contracting Officer, or purple where required, as noted.

2.08 Pop-up Spray Heads and Bubblers:

A. Sprinkler heads are specified on the drawings. Spray heads shall have a minimum 4 inch pop-up.

B. The sprinkler body and all related parts shall be plastic cycolac or polycarbonate. They shall have a spring retraction for positive return action of the pop-up nozzle.

C. The spring for retraction and the adjustable nozzle screw shall be made of corrosion resistant materials.

2.09 Drip Tube and Emitters:

Drip tube shall be of the manufacturer and model as noted on the plans. Pressure compensating emitters with internal check valves are required unless noted otherwise.

A. All barbed insert fittings shall be constructed of molded, ultra-violet-resistant plastic having a nominal inside dimension (I.D.) of 0.24".

B. Each fitting shall have a minimum of two ridges or barbs per outlet with a raised barb nearest the fitting outlet. All fittings shall be of one manufacturer and shall be available in one of the following end configurations: barbed insert fittings, male pipe threads (MPT) with barbed insert fittings, or female pipe threads (FPT) with barbed insert fittings.

2.10 Electric Controller:

A. The electric irrigation controller shall be as noted on the plans. The system may be designed to operate multiple section valves at a time, per controller unless otherwise noted.

B. Power source shall be 110v A.C. Output for operation of companion solenoid actuated valves shall be 24 volts 60 Cycle AC.

2.11 Electric Remote Control Valves:

A. Electric remote control valves shall have plastic bodies and covers and shall be globe-type diaphragm valves of normally closed design. The valves are specified on the drawings.

B. Operation shall be accomplished by means of integrally mounted heavy-duty 24-V DC solenoid complying with National Electrical Code, Class II Circuit. Solenoid coil shall be potted in epoxy resin within a plastic coated stainless steel housing. Solenoids shall be completely waterproof, suitable for direct underground burial.

C. A flow stem adjustment shall be included in each valve.

2.12 Backflow Preventer:

A. An approved backflow prevention device is required, as noted on the plans. The device shall include all materials as required by the local municipality and shall be inspected accordingly.

2.13 Temperature and Rain Sensors:

A. Rain and freeze sensors shall be provided and installed as noted on the plans.

PART 3 – EXECUTION

3.00 GENERAL:

A. Design Pressure: This irrigation system has been designed to operate with a minimum static inlet water pressure as indicated on the drawings. The Contractor shall take a pressure reading prior to beginning construction. If the pressure reading is 5% less than above, the Contractor shall notify the Owner's Representative.

B. Contractor Responsibility: The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in equipment usage, area dimensions or water pressure exist that might not have been considered in the engineering. Such obstructions or differences shall be brought to the attention of the Owner's Representative in writing. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary.

C. Staking: Before installation is started, place a stake or flag where each sprinkler is to be located, in accordance with drawing. Staking shall be approved by the Landscape Architect before proceeding.

D. Piping Layout: Piping layout is diagrammatic. Route piping around existing trees and root zones in such a manner as to avoid damage to plantings. Do not dig within the ball of newly planted trees or shrubs.

E. In areas where trees are present, trenches will be adjusted on site to provide a minimum clearance of four times the trunk diameter of the tree (at its base) between any tree and any trench.

F. All material and equipment shall be delivered to the Worksite in unbroken reels, cartons or other packaging to demonstrate that such material is new and of a quality and grade in keeping with the intent of these Specifications.

3.01 Excavation and Trenching:

A. The Contractor shall perform all excavation to the depth indicated in these Specifications and Contract drawings. The banks of trenches shall be kept as nearly vertical as practicable. Trenches shall be wide enough to allow a minimum of 4" between parallel pipelines or electrical wiring. Where rock excavation is required, or where stones are encountered in the bottom of the trench that would create a concentrated pressure on the pipe, the rock or stones shall be removed to a depth of six (6) inches minimum below the trench depth indicated. The over depth rock excavation and all excess trench excavation shall be backfilled with loose, moist earth or sand, thoroughly tamped. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe is encountered in the trench bottom, such shall be removed to a depth and length required, and the trench backfilled to trench bottom grade as hereinafter specified, with course sand, fine gravel or other suitable material.

B. Bottom of trench grade shall be continued past ground surface deviations to avoid air pockets and low collection points in the line. The minimum cover specifications shall govern regardless of variations in ground surface profile and the occasional deeper excavation required at banks and other field conditions. Excavation shall be such that a uniform trench grade variation will occur in all cases where variations are necessary.

C. Trench excavation shall comprise the satisfactory removal and disposition of all materials, and shall include all shoring and sheeting required to protect the excavation and to safeguard employees.

D. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance back from edge of trenches to avoid overloading and prevent slides or cave-ins. Material unsuitable for backfilling shall be wasted as directed by the Owner’s Representative. When excavated material is of a rocky nature and the topsoil or any other layer of excavated material is suitable for pipe bedding and backfill in the vicinity of the pipe, such material shall be separately stockpiled for use in such bedding and pipe backfill operations, unless satisfactory imported material is used.

E. All excavations and backfill shall be unclassified and covered in the basic bid. No additional compensation will be allowed for rock encountered.

F. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations to their original conditions in a manner acceptable to the Owner’s Representative.

3.02 Pipe Installation:

A. Sprinkler Mains: Sprinkler mains are that portion of piping from water source to electric valves. This portion of piping is subject to surges since it is a closed portion of the sprinkler system. Sprinkler mains shall be installed in a trench with a minimum of 18 inches of cover.

B. Lateral Piping: Lateral piping is that portion of piping from electrical valve to sprinkler heads. This portion of piping is not subject to surges since it is an "open end" portion of the sprinkler system. Lateral piping shall be installed in a trench with a minimum of 12 inches of cover.

3.03 PVC Pipe Fitting and Assembly:

A. Solvent: Use only solvent recommended by manufacturer to make solvent-welded joints following standards noted herein. Thoroughly clean pipe and fittings of dirt, dust, and moisture with an approved PVC primer before applying solvent.

B. PVC to Metal Connection: Work metal connections first. Use a non-hardening pipe dope such as Permatex No. 2 or "Teflon" tape on threaded PVC to metal joints. Use only light wrench pressure.

C. Threaded PVC Connections: Where required, use threaded PVC adapters into which pipe may be welded.

D. Remove lumber, rubbish, and rocks from trenches. Provide firm, uniform bearing for entire length of each pipeline to prevent uneven settlement. Wedging or blocking of pipe will not be permitted. Remove foreign matter or dirt from inside of pipe before welding, and keep piping clean during and after laying pipe.

E. PVC pipe shall not be installed where there is water in the trench, nor shall PVC pipe be laid when temperature is 40 deg. F or below or when rain is imminent. PVC pipe will expand and contract as the temperature changes. Therefore, pipe shall be snaked from side to side of trench bottom to allow for expansion and contraction.

3.04 Hydrostatic Tests:

Pressure Test: After the pipe is laid, the joints completed, and the trench partially backfilled, leaving the joints exposed for examination, the newly laid mainline pipe or any valved section of main pressure line piping shall, unless otherwise specified, be subjected for four hours to a hydrostatic pressure test of normal city water pressure. Each valve shall be opened and closed during the test. Enclosed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade, as necessary. Cracked or defective pipe, joints, fittings, or valves discovered in consequence of this pressure test shall be repeated until the test results are satisfactory. All replacement and repair shall be at contractor's cost.

3.05 Control Wire Installation:

A. All control wire less than 500 feet in length shall be continuous without splices or joints from the controller to the valves. Connections to the electric valves shall be made within 18 inches of the valve using connectors specified in Paragraph 2.4 of this section, unless otherwise approved by the Owner’s Representative in writing.

B. All control wires shall be installed at least 18 inches deep. Contractor shall obtain the Owner’s Representative's approval for wire routing when installed in a separate ditch. Control wires may be installed in a common ditch with piping, however wires must be installed a minimum of 4 inches below or to one side of piping.

C. All wire passing under existing or future paving, sidewalk, construction, etc., shall be encased in PVC conduit extending at least 2 feet beyond edges of paving, sidewalks, or construction.

3.06 Pop-up Spray and Bubbler Heads:

A. Provide heads and nozzles as specified and install in locations as shown on the Contract Drawings.

B. Pop-up spray heads shall be installed with connections to rigid PVC pipe as detailed on the Contract drawings. Rotary heads shall be installed on a double swing joint connected to the lateral pipe as detailed on the drawings.

C. Heads shall be installed with underside of flange flush with the finished grade.

D. Contractor will be required to adjust heads as necessary after establishment of grass or other plant material.

3.07 Drip Equipment:

A. Drip tube can be installed in one of the four following methods:

Over-excavation: Over-excavate the entire area to a depth of 2" to 4" below finish grade. Plant all specimen trees and shrubs 15 gallon size and larger, then place drip tube at the row spacing interval indicated on the plans.

Pipe-Pulling: Where ground disruption is to be minimized, pneumatic tire, pipe-pulling machinery shall be used. Potholes shall be used at the ends of each run for making connection to supply and exhaust headers of rigid PVC pipe or polyethylene pipe.

Trenching: Hand or mechanically trench to the pipe depth indicated on the plans or in these specifications and backfill flush with finish grade. Avoid mechanically trenching within the dripline of existing trees. Hand-trench around existing tree roots when roots of 2" and larger are encountered. Remove all rock 1½" and larger when excavating and remove from site. Do not backfill trenches with rock that will come in direct contact with tubing or rigid PVC piping.

B. Placement of Rigid PVC Piping: Install pipe in a serpentine (snaked) manner to allow for expansion and contraction in trench before backfilling. Install pipes at temperatures over 40° F. Pipe markings shall face upward out of the trench whenever possible.

C. Drip tube: Drip tube can be installed with the water outlets facing up, down, or sideways. In irregular areas, some water outlets could end up too close to fixed improvements and may have to be capped off with a dripper plug ring.

D. Cover: Install underground piping horizontally and as evenly as possible to a maximum depth of 4", unless otherwise specified. (Typical pipe depth is 2" shrub beds, 4" in turf unless periodic aeration is anticipated, and then pipe depth should be lowered to 6".)

E. Barbed Insert Fittings: Connect drip tube to barbed insert fittings by pushing the tubing and over both barbs of the fitting until the tubing has seated against another piece of tubing or has butted against another portion of the barbed fitting. For water pressures in excess of 30 psi, or the maximum stated system pressure for the drip tube, whichever is less, use stainless steel clamps as noted in paragraph 3.2.4, "Pipe Clamping" on all barbed fittings.

F. Clamping: When design-operating pressure exceeds 30 psi, or maximum stated system pressure for the drip tube, whichever is less, stainless steel pipe clamps shall be used. Slip clamps over tubing before slipping tubing over barbed insert fitting. Place clamp between the first and second ridge of the barbed fittings and crimp the "ear" of the clamp tightly. Crimp the "ear" twice to ensure proper seating.

3.08 Quick-Coupler Valves:

A. Quick coupling valves shall be installed with the underside of flange flush with the finished grade.

B. Quick coupling valves shall be installed on a swing joint assembly as detailed on the drawings.

C. Under the warranty, the Contractor shall return after grass is established and adjust valves and valve boxes to proper grade.

3.09 Manual Valves:

A. Manual valves shall be sized and located where shown on the Contract drawings.

B. Valve boxes shall be adjusted to be flush with finished grade. The Contractor will be required to adjust after establishment of grass.

C. Valve boxes shall be properly supported and of sufficient construction that tractors and mowers crossing over the boxes will not push boxes down and crush the pipe, valve, or box.

3.10 Valve and Valve Box Placement:

A. All manual, electric, and quick coupling valves shall be in boxes as specified in Paragraph 2.7 of this section, and shall be set with a minimum of six (6) inches of space between their top surface and the bottom of the valve box. The base of the box shall be filled with pea gravel as

B. Valves shall be fully opened and fully closed to ensure that all parts are in operating condition.

C. Valve boxes shall be set plumb, vertical, and concentric with the valve stem.

D. Any valve box which has moved from this required position to prevent the use of the operating wheel of the valve shall be reset by the Contractor at his own expense.

3.11 Electric Controller:

A. Electric controller location shall be confirmed with the Landscape Architect, Architect, and Owner before installation, as shown on the plans.

3.12 Electric Remote Control Valve:

A. Remote control valves shall be located and sized as shown on the plans. All electrical connections shall be made when the weather is dry with connection kits as specified in Paragraph 2.4 of this section in strict accordance with manufacturer's recommended procedures. All remote control valves shall be installed in a horizontal position, in accordance to the manufacturer's published installation instructions.

B. It shall be the responsibility of the Contractor to furnish and install the proper size wire on each of the low voltage circuits from the master control center to the various electric remote control valves.

C. Consideration shall be given to each circuit for allowance of voltage drop and economy consistent with accepted practices of electrical installation. Under no circumstances shall the voltage of any branch circuit be reduced more than proper due to length of run exceeding the maximum allowable for the wire size used.

3.13 Backfill and Compaction:

A. After system is operating and required tests and inspections have been made, the trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, gravel, soft shale, or other approved materials, free from large clods of earth or stone. Rock, broken concrete, or pavement, and large boulders shall not be used as backfill material. The backfill shall be thoroughly compacted and evened with the adjacent soil level.

B. Compact trenches in areas to be planted by thoroughly flooding the backfill. Compact all other areas by flooding or hand tamping. The jetting process may be used in areas when flooding.

C. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to a minimum of 90% density.

D. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for compaction, then refilled and compacted with the surface restored to the required grade and left in a completed surface condition as described above.

E. Specifically tamp backfill under heads and around the flange of heads for one foot (1') by a suitable means after trench backfill has dried from flooding to prevent heads loosening in the ground.

3.14 Final Adjustment:

A. After installation has been completed, make final adjustment of sprinkler system prior to Owner’s Representative's final inspection.

B. Completely flush system to remove debris from lines by removing nozzle from heads on ends of lines and turning on system.

C. Check sprinklers for proper operation and proper alignment for direction of throw.

D. Check each section for operating pressure and balance to other sections by use of flow adjustment on top of each valve.

E. Check nozzles for proper coverage. Prevailing wind conditions may indicate that arc or angle of spray should be other than as shown on drawings. In this case, change nozzles to provide correct coverage and furnish record data to Owner’s Representative with each change.

F. After system is thoroughly flushed and ready for operation, each section of sprinklers shall be adjusted to control pressure at heads. Use the following method, one section at a time:

1. Remove last head on section and install a temporary riser above grade. Install tee with pressure gauge attached on top of riser and re-install head with nipple onto tee.
2. Correct operating pressure at last head of each section as follows: Spray Heads - 30-35 psi.

3. After replacing head, at grade, tamp thoroughly around head.
4. Drip zone valve pressure regulating devices shall be set at not to exceed 40 psi.

3.15 Clean-up:

A. The Worksite shall be thoroughly cleaned of all waste materials and all unused or salvaged materials, equipment, tools, etc.

B. After completion of the work, areas disturbed shall be leveled and the Worksite shall be raked clean and left in an orderly condition.

END OF SECTION

SECTION 32 91 14

PLANTING MEDIA

PART 1 - GENERAL

1.01 Work Included

A. Provide materials, testing, equipment and labor required to prepare amended plant mediums for:

1. Planting Backfill Mix
2. Tree Planting Pit Backfill Mix
3. Shrub Bed Planting Backfill Mix
4. Slope Stabilization Mix
5. Mulch

1.02 Related Sections

A. Plants: Section 32 9300

1.03 Quality Assurance

A. If requested by owner, all soil components shall be tested by local or state testing laboratory for conformity to the specifications:

1. Contractor shall submit proposed laboratory name, address, and telephone numbers for approval.

B. For delivered material, test one grab sample for each 100 c.y. of bulk material delivered to the site.

C. Excavated material from tree pits and shrub beds shall not be used for preparation of backfill mix.

1.04 Submittals

A. Contractor shall submit 1 quart bags of soil mixes and mulch, labeled according to mix and source, along with macro and micro nutrient analysis to landscape architect for approval prior to delivery to the job site. All Mulch and Compost shall be STA approved.

B. Planting media mix data from manufacturer.

C. Manufacturer's product data information and installation instructions. Include required preparation, materials, and application rate

D. Contractor shall submit data indicating the products meet or exceed all technical requirements.

1.05 Inspections

A. Testing will be at the expense of the contractor.

1.06 Product Delivery, Storage and Handling

A. Deliver material to site when permitted by the owner and only when project is ready for related work.

PART 2 - PRODUCTS

2.01 On Site Materials

A. Specified backfill mixes shall consist of like material to that used for landscape grading.

2.02 Planting Mix

A. Basis of Design - Planting mix for grasses shall be 'Top Soil/Cow Manure Mix', Desert Rock Co, El Paso, TX (915) 859-5969, or approved equal.

B. Basis of Design – Soil mix for cacti and succulents shall be 'Cactus King's Proprietary Soil Blend', Cactus King, Houston, Texas (281) 591-8833, or approved equal.

PART 3 - EXECUTION

3.01 Mixing

A. Mix soil base, amendments and chemical additives by mechanical means. Do not mix additives with excavated material at the plant pit site.

B. Thoroughly mix all amendments in specified proportions prior to installation. Mix may be pre-blended or blended on site. Mix shall be approved by landscape architect prior to installation.

C. Soil and sand bases shall be completely pulverized and free of lumps or aggregated material. Moisture content of base materials shall not be such that chemical, granular or pelletized additives become dissolved during the mixing process.

D. Mix media in quantities of not less than 50 cubic yards or mix total quantity required, if less than 100 cubic yards. The Contractor shall be responsible for batch continuity.

E. For hydroseed additives, do not incorporate soil from mixing area with mix. Strictly comply with equipment manufacturer's installation instructions and recommendations. Use approved hydroseeding machines. To achieve optimum soil surface coverage, apply BSM from opposing directions to soil surface.

END OF SECTION

SECTION 32 9300

PLANTS

PART 1 – GENERAL

1.01 Work Included

A. This Section includes specifications for furnishing and installing planting materials and includes:

1. Organic and chemical fertilizer

2. Mulch

3. Planting media and accessories

1.02 Related Sections

A. Planting Irrigation: Section 32 8400

B. Planting Media: Section 32 9114

1.03 Standards

A. American National Standards Institute (ANSI)/American Association of Nurserymen (AAN): ANSI Z60.1 1-069 "Nursery Stock".

B. "Grades and Standards", latest edition of Texas Association of Nurserymen Specifications, Austin, Texas 78704.

C. Perform work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by federal, state, and local authorities in furnishing, transporting, and installing materials.

1.04 Quality Assurance

A. Installer: Installation of planting work shall be performed by a single firm specializing in landscape and planting work. Contractor shall be licensed by the Texas Association of Nurserymen, shall possess an agricultural certificate, shall be a licensed pest applicator, and shall have not less than 5 years of experience in this type of work.

B. Installer's field supervision: Require Installer to maintain an experienced full-time supervisor on project site when work is in progress.

1. Pesticide Applicator: State licensed for commercial work is required.

C. Compliance: Ship planting materials with Certificates of Inspection as required by governing authorities. Comply with all applicable local, state, and federal requirements regarding materials, methods of work, and disposal of excess and waste materials.

D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1. Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions or disfigurement.

E. Analysis and Standards: All packaged products shall be delivered in original manufacturer's sealed containers. For unpackaged materials, submit analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

1.05 Material Inspections

A. Plants shall be subject to inspection and approval by Landscape Architect upon delivery for conformity to specifications, prior to installation. Landscape Architect may reject plant material that, in the Landscape Architect's opinion, does not conform to specifications. Submit a written or verbal request for inspection of plant material to Landscape Architect at least five (5) working days prior to preferred date. The Landscape Architect reserves the right to refuse inspection at this time if it appears that a sufficient quantity of plants is not available for inspection. The contractor shall submit alternate source for material if the primary source of material is deemed unsatisfactory to meet specifications.

B. Substitutions of plant materials will not be permitted unless authorized in writing by Landscape Architect. If proof is submitted that any plant specified is not obtainable from a variety of sources, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of contract price. Such proof shall be substantiated and submitted in writing to Landscape Architect at least thirty (30) days prior to start of work under this Section. These provisions shall not relieve contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

C. Contact Landscape Architect for inspection after planting operation has been completed. The Contractor will submit photos of the material installed to the Landscape Architect, and the Landscape Architect will determine whether progress indicated by the photos warrants inspection. The Landscape Architect reserves the right to refuse inspection if sufficient progress is not indicated by the submitted photos. Such inspection is for the purpose of establishing the maintenance period.

D. Request inspections to the Landscape Architect no less than seven (7) working days prior to anticipated inspection date.

1.06 Submittals

A. Furnish photos of plant materials with species and sources clearly labeled on photo, manufacturers literature, samples, certifications, or laboratory analytical data for the following items:

1. Tree, shrub, and groundcover photographs. Tree photos shall include calipers indicating required trunk diameter, and rod indicating required height, clearly legible. Unlabeled submittals will be rejected.
2. Planting backfill mix (laboratory analysis and 1-quart sample bag)
3. Mulch (manufacturer's literature and 1-quart sample bag s)
4. Tree and shrub planting fertilizer (certification or laboratory analytical data)
5. Tree paint (manufacturer's, literature)
6. Subdrainage materials (pipes, gravel, soil separator), if applicable
7. Geotextile Fabric, if applicable.

1.07 Plant Material Delivery, Storage and Handling

A. The following considerations for product handling shall be evaluated:

1. During hot weather and when practical, the contractor may be required to transport plant materials between sunset and sunrise if transported in an open trailer or unrefrigerated van.

2. Dug material, if accepted, should be maintained and watered as required at the nursery to guarantee their vitality and health until shipping.

3. Protect from all damage trunks, stems, branches and root balls during tree tying, wrapping and loading operations.

4. Load containers onto transport vehicle and secure in a manner that protects the structural integrity of the root balls and branches.

5. The contractor shall be solely responsible for the safe transportation of plants to the site and their condition upon arrival. Trees damaged, dehydrated or abused during transit and storage will be rejected.

6. Plant materials should not be stored on concrete or left exposed to examples of climate without adequate protection.

8. Protect the root balls and water regularly until planting. If trees are left in storage over the weekend or holiday provide a means of periodical watering and inspection of container moisture.

8. B & B material (if accepted) shall be stored and maintained in a manner which affords protection from dehydration and damage of root ball. Root balls shall be wrapped and stored in mulch or approved containers.

B. The Landscape Architect may inspect any phase of this operation and may reject any plant material improperly handled during any point of this operation.

C. Nothing in this section shall be interpreted as relieving the contractor of his responsibility to provide healthy, viable plants, nor shall it have any affect upon the terms of the warranty specified herein.

1.08 Incidental Repairs

A. The landscape contractor shall coordinate repairs of damage to irrigation system incidental to the planting operation by either own forces or by irrigation subcontractor. Above repairs shall be made immediately so as to not interfere with the automatic cycling of the irrigation system. All repairs shall be permanent and include all flushing required to clean the lines of debris deposited by such damage.

B. Incidental damage to work by other subcontractors during landscape installation shall be repaired immediately and at no extra cost to the owner, nor to the Landscape Contractor. The Landscape Contractor shall photo-document incidental damage and indicate date and location of occurrence.

1.09 Job Conditions

A. Work Scheduling: Proceed with and complete planting work in a timely manner, working within seasonal limitations for each kind of planting work required. The General Contractor shall coordinate other trade access and methods, to avoid damage to the landscape installation.

B. Planting Time

1. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

2. Plant trees, shrubs and groundcover after final grades are established and prior to planting of lawns, unless otherwise directed by Landscape Architect or owner's representative in writing. If planting occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

C. Utilities: Refer to drawings and coordinate with utility contractor for location of utilities. Contractor shall be responsible for damage to existing utilities and structures.

D. Security: The Owner will not assume any responsibility for security of any materials, equipment, etc. during construction of the project until project acceptance.

E. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, concrete wash-out areas, over-excavation, adverse drainage conditions beyond the scope of this contract, or obstructions, notify owner's representative of such conditions immediately and before planting.

F. Pollution Control: Control dust caused by planting operations. Dampen surfaces as necessary. Comply with pollution control regulations of governing authorities.

PART 2 - MATERIALS

2.01 Plants

A. Plants shall be nursery grown in accordance with good horticultural practices under climatic conditions similar to those of project for at least 12 (twelve) months unless specifically otherwise authorized by Landscape Architect in writing. Unless specifically noted otherwise, all plants shall be heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be superior in form, number of branches, compactness and symmetry.

B. Plants shall be sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall be free of disease, insect pests, eggs, or larvae, and shall have healthy, well developed root systems. They shall be free from physical damage or adverse conditions that would prevent thriving growth.

C. Plants shall be true to species and variety and shall conform to measurements specified except that plants larger than specified may be used if approved by Landscape Architect. Use of such plants shall not increase contract price. If larger plants are approved, the ball of earth or container size shall be increased as specified under “Applicable Standards” and subject to the approval of the Landscape Architect.

D. Plants shall be measured when branches are in their normal position. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Height measurement shall be shown from the plant base/root flare upwards. Caliper measurement shall be taken at a point on the trunk six inches (6") above natural ground for material four inches (4") in caliper, and at a point twelve inches (12") above the natural ground line for trees over four inches (4") in caliper. Multi-trunk material shall consist of 1” caliper trunks, minimum, and no more than six trunks, unless otherwise specified. If a range of size is given, no plant shall be less than the minimum size and not less than 40% of the plants shall be as large as the maximum size specified. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required. Plants that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected.

E. Container stock shall have grown in the containers in which delivered for at least six months, but not over two years. Samples must prove no root bound conditions exists. No container plants that have cracked or broken balls or earth when taken from container shall be planned. Container stock shall not be pruned before delivery. Field grown plants recently transplanted into containers will not be accepted.

F. Balled and burlap trees, if accepted, shall have a root ball size of ten (10X) times the caliper minimum. Photo documentation of these dimensions, prior to installation, is required.

1. Nursery grown B&B material shall be first pruned and thinned at the place of growth immediately prior to digging as required for packaging and safe moving. Method or pruning shall be as approved in the field by the Landscape Architect. Do not remove self-locking tags during this pruning prior to delivery to site. Final pruning shall take place at the site.

G. Method of pruning shall be as approved in the field by the Landscape Architect. Do not remove self-locking tags during this pruning prior to delivery to site. Final pruning shall take place at the site.

H. Plant Materials

1. Refer to landscape plans and plant schedule for species and quantity

2.02 Water

A. Furnished by owner. Transport as required.

2.03 Pre-Emergence Weed Control

A. All planting areas shall be treated with organic pre-emergent herbicide whenever possible. Reference Turf and Grasses Section 32 9200

2.04 Planting Mix

A. See Planting Media: Section 32 9114

2.05 Fertilizer

A. Post planting fertilization shall be 100% organic.

1. Microlife or approved equal and apply at manufacturer's recommendation rate.

2.06 Aluminum Edging

A. Typical aluminum edging shall be 3/16” thickness by 4” height with 2.6 lbs/ft. unless indicated in the drawings.

B. Contract shall submit product data for approval prior to installation.

2.07 Weed Barrier / Geotextile Fabric

A. Typar #3401 terminally spunbonded polypropylene, non-woven, weed control fabric, 4.0 oz / lineal yard weight by American Excelsior or approved equal.

B. Contractor is required to submit samples and product data for approval prior to installation.

PART 3 - EXECUTION

3.01 Layout and Excavation of Planting Areas

A. Layout plants in locations shown on drawings. Use wire stakes color-coded for each species of plant material or spray paint with non-toxic paint to delineate each plant species and outline bed locations. Each tree shall be staked for approval prior to planting.

B. The Landscape Architect will check location of plants in the field and shall adjust to exact position before planting begins.

C. If underground obstructions are encountered notify the Landscape Architect as to whether an adjustment or change of location is possible within the design intent. If the contractor is allowed to adjust or change location, rather than remove the obstruction, he shall make the change at no expense to the owner. Backfill and tamp abandoned pits have obstructions which cannot be removed.

3.02 Excavation to Subgrade for Planting Area and Verification of Finished Grade

A. Excavate all planting areas (pit and beds) to required depth as hereinafter specified and stockpile enough material to prepare planting mix for all plants. Remove excess material from site.

B. Verify that required grades are within two (2”) inches of required subgrade provided under a separate contract and excavate further as may be required.

C. Subsoil shall not be worked when moisture content is so great that excessive compaction will not occur, nor when it is so dry that clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content before tilling and planting.

D. Excavate shrub and ground cover beds to the following depths:

Excavation for	Width	Depth
Shrubs &	Entire Bed	Container + 4 in., not less than 12 in
Groundcover	Entire Bed	Container + 4 in., not less than 8 in

E. Rip or cultivate subgrade in pits and beds to a depth of three (3”) inches minimum.

3.03 Drainage, Detrimental Soils and Obstructions

A. Test drainage of plant beds and pits by filling with water twice in succession. Conditions permitting the retention of water in planting beds for more than twenty-four (24) hours or percolation of less than one (1") inch per hour shall be brought to the attention of the Landscape Architect.

B. Notify the Landscape Architect of all soil or drainage conditions contractor considers detrimental to growth of plant material. (State condition and submit proposal and cost estimate for correcting condition.)

C. If rock, hardpan, underground construction work, tree roots, or other obstructions are encountered in the excavation of plant pits and beds, alternate locations may be selected by Landscape Architect. Where locations cannot be changed, submit cost required to remove the obstructions to a depth of not less than six (6") inches below the required pit or bed depth. Proceed with work after approval.

3.04 Preparing Plant Materials for Planting

A. Container grown stock shall be removed carefully and handled only by the root ball. Do not lift or handle container plants by tops, stems, or trunks at any time.

B. Do not bind or handle any plant with wire or rope at any time so as to damage bark or break branches. Lift and handle plants only from bottom of ball.

C. Balled and burlap (B&B) plants shall have firm balls of earth. Plants moved with a ball will not be accepted if the ball is cracked or broken before or during planting operations. B&B material shall be dug only when dormant. Pre-dug stored B&B material shall be inspected and approved at the storage site.

3.05 Installation of Pit Planted Materials

A. Do not commence any planting until the irrigation system is completely automated or can be operated manually.

B. Fill plant pits with soil mix to compact depth to receive plant root ball, so top of root ball is two (2") inches above finished grade.

C. Install PVC watering tubes in tree pits, vertically, at edge of pit as shown.

D. Scarify the walls and bottom of all plant pits immediately prior to the placement of plant and backfill mix. The Contractor shall remove all glazing caused by an auger or mechanical hole digger.

E. For boxed & container grown material, break vertical bands and remove top and bottom of container. Carefully lower plant into pit with backhoe or approved method and adjust elevation. Cut horizontal banks and remove sides. Prune away girdled roots and tease root hair masses. Carefully fill pit and compact by watering in to support root ball.

F. Place B&B plants carefully in the prepared planting pit. Do not disturb root ball or untie twine or roping until backfill settlement is complete, and tree is staked, if applicable. Fill planting pit by flooding each eight (8") inches of backfill for balls greater than 24" diameter. Wrap trunks with double layer of tree wrap.

G. Smooth planted areas to conform to specified grades after full settlement has occurred. Contractor shall bear final responsibility for proper surface drainage of planted areas. Any discrepancy in the drawings or specifications, obstructions on the site, or prior work done by another party, which contractor feels precludes establishing proper drainage, shall be brought to the attention of the Landscape Architect in writing.

H. Mulch circles shall not exceed width of root mass by more than 4". Mulch circles shall meet lawn or bed grades evenly and smoothly.

I. Water all plants immediately again after planting.

J. Spread mulch in required areas to the compacted depth of two (3") inches.

3.06 Installation of Bed Planted Materials

A. Install aluminum edging where shown. Anchor with aluminum stakes spaced not more than three (3’) feet O.C. or as per often as necessary to have smooth radius or straight tangent. Drive stake to one (1”) inch below top of edging.

B. Fill all shrub and groundcover beds with plant bed mix to finished grade (compacted) plus two (2”) inches minimum.

C. Excavate in planting mix for individual plant and install as required. Set plant plumb and brace rigidly in position until planting soil mix has been tamped solidly around the ball and roots.

D. When plant pits have been backfilled approximately two-thirds (2/3) full, fertilizer per manufacturer'' recommendations at the maximum rate.

E. Water plant thoroughly, saturating root ball, before installing remainder of the planting soil to top of pit, eliminating all air pockets. Top of root ball shall be two (2”) inches above finished grade.

F. Smooth planting areas to conform to specified grade after full settlement has occurred. Contractor shall bear final responsibility for proper surface drainage of planting areas.

F. Water all plants immediately again after planting.

3.07 Surface Drainage of Planting Areas

A. Contractor shall bear final responsibility for proper surface drainage of planted areas. Any discrepancy in the drawings or specifications, obstructions on the site, or prior work done by another party, which contractor feels precludes establishing proper drainage, shall be brought to the attention of the Landscape Architect in writing.

3.08 Pruning

A. Prune containerized plants only at time of planting and according to standard horticultural practice to preserve the natural character of the plant. Prune by removing entangled branching and by removing crotches. Avoid removing branch tips wherever possible. Pruning shall be done under supervision of the Landscape Architect.

B. Remove all dead wood, suckers, and broken or badly bruised branches. Use only clean, sharp tools.

C. Prune lower branching from trees to a height of 18" above ground per 1 1/4" caliper.

D. Prune B&B material in addition to place of growth as may be directed by Landscape Architect by removing a percentage of interior branching proportional to the root loss during digging (up to 1/3).

3.09 Maintenance by the Contractor

A. The contractor shall begin maintenance after each plant is installed and continue until final acceptance.

B. The contractor's maintenance period shall begin upon inspection and approval at Substantial Completion and shall be for 90 days or to be determined by owner.

C. The contractor's maintenance of new planting shall consist of watering, cultivating, weeding, mulching, re-staking, tightening and repair of guys, resetting plants to proper grades or upright position, and furnishing and applying such pesticide sprays and invigorates as are necessary to keep the plantings free of insects and disease and in thriving condition.

D. Protect planting areas and plants at all times against damage of all kinds for duration of maintenance period. Maintenance includes temporary protection barriers and signs as required for protection. If any plants become damaged or injured, because sufficient protection was not provided, treat or replace as directed by Landscape Architect at no additional cost to the owner.

3.10 Final Acceptance

A. Work under this section will be accepted by Landscape Architect upon satisfactory completion of all work, including maintenance, but exclusive of replacement of plant materials under the warranty period. Upon termination of maintenance period, the owner will assume responsibility for maintenance of the work.

3.11 Warranty

A. Planting shall be warranted by the contractor to remain alive and healthy for a period of 12 months after the date of Substantial Completion. Plants in an impaired, dead or dying condition after initial acceptance or within 12 months shall be removed and replaced. New planting and method of placing shall comply with the requirements of the specifications. Plants replacing those removed during the guarantee period shall also be guaranteed to remain alive and healthy for an additional 12 months after installation and acceptance.

B. Contractor shall not be held responsible for failure due to neglect by owner or property manager, vandalism, acts of god, during warranty Period. Report such conditions to the Landscape Architect or owner's representative in writing when discovered.

C. Contractor shall indicate during Pre-Bid regarding warranty status of plant material in the case of no irrigation system provided in the project.

D. Submit a letter of warranty containing the following information:

1. "We hereby guarantee that the landscape planting we have furnished and installed is free from disease and in good condition, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted.

   We agree to repair or replace any defects in material or workmanship which may develop during the period of one (1) year from acceptance, and also to repair or replace any damage resulting from the repairing or replacing of such defects, at no additional cost to the owner. We shall make such repairs or replacements within a reasonable time, as determined by the owner, after receipt of written notice.

   In the event of our failure to make such repairs or replacements within a reasonable time after receipt of written notice from the owner by certified mail, we authorize the owner to proceed to have said repairs or replacements made at our expense, and we will pay the costs and charges therefore, upon demand."

3.12 Clean Up

A. Clean up all areas as required for complete and acceptable inspection.

B. It is Contractor's responsibilities to replace or restore any damaged or disturbed areas during planting operation back to its original condition.

3.13 Inspections

A. Submit requests for inspections to the Landscape Architect at least five (5) days prior to anticipated inspection date, in accordance with Section 1.05 C of this specification.

END OF SECTION

SECTION 33 05 13

MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Construct junction boxes, manholes, and inlets, complete in place or to the stage detailed, including furnishing and installing frames, grates, rings, and covers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General

1. Cast-in-place junction boxes, manholes, inlets, risers, and appurtenances are acceptable unless otherwise shown. Alternate designs for cast-in-place items must be acceptable to the Engineer and must conform to functional dimensions and design loading. Alternate designs must be designed and sealed by a licensed professional engineer.

B. Concrete

1. Furnish Class H concrete as referenced in the TxDOT Standard Specifications, Item 421 "Hydraulic Cement Concrete," except that Mix Design Options 1–8 will be allowed for formed precast junction boxes, manholes, and inlets. Furnish concrete per DMS 7310, "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification," for machine-made precast junctions boxes, manholes, and inlets. Furnish Class C concrete for cast-in-place manholes and inlets unless otherwise shown on the plans.

C. Mortar

1. Furnish mortar conforming to DMS 4675, "Cementitious Grouts and Mortars for Miscellaneous Applications."

D. Timber

1. Provide sound timber that is a minimum of 3 in. nominal thickness and reasonably free of knots and warps for temporary covers when used with Stage I construction (see TxDOT Standard Specifications Article 465.3., "Construction").

E. Other Materials

1. Use commercial-type hardware as approved.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. General

1. Construct all types of junction boxes, manholes, and inlets either complete or in 2 stages, described as Stage I and Stage II.
2. Construct the Stage I portion of junction boxes, manholes, and inlets as shown on the plans or as specified in this Item. Furnish and install a temporary cover as approved.
3. Furnish and install the storm drain pipe and a temporary plug for the exposed end of the storm drain pipe from the storm drain to a point below the top of curb indicated on the plans for Stage I construction of cast iron or steel inlet units.

4. Construct Stage II after the pavement structure is substantially complete unless otherwise approved.
5. Construct the remaining wall height and top of junction box, manhole, or inlet for Stage II, and furnish and install any frames, grates, rings and covers, curb beams, or collecting basins required.
6. Construct cast-in-place junction boxes, manholes, and inlets in accordance with the TxDOT Standard Specifications Item 420, "Concrete Substructures." Forms will be required for all concrete walls. Outside wall forms for cast-in-place concrete may be omitted with approval if the surrounding material can be trimmed to a smooth vertical face.

B. Precast Junction Boxes, Manholes, and Inlets
1. Construct formed precast junction boxes, manholes, and inlets in accordance with the TxDOT Standard Specifications Item 420, "Concrete Substructures," except as otherwise noted in this Item. Construct machine-made precast junction boxes, manholes, and inlets in accordance with ASTM C478 except as otherwise noted in this Item. Mix and place concrete for machine-made junction boxes, manholes, and inlets per the requirements of DMS 7310, "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification." Conform to the product permissible variations and rejection criteria stated in ASTM C478 for machine-made precast junction boxes, manholes, and inlets. Cure all precast units in accordance with Item 424, "Precast Concrete Structural Members (Fabrication)."
2. Lifting Holes. Provide no more than 4 lifting holes in each section for precast units. Lifting holes may be cast, cut into fresh concrete after form removal, or drilled. Provide lifting holes large enough for adequate lifting devices based on the size and weight of the section. The maximum hole diameter is 3 in. at the inside surface of the wall and 4 in. at the outside surface. Cut no more than 5 in. in any direction of reinforcement per layer for lifting holes. Repair spalled areas around lifting holes.
3. Marking. Clearly mark each precast junction box, manhole, and inlet unit with the following information:
   a. name or trademark of fabricator and plant location;
   b. product designation;
   c. ASTM designation (if applicable);
   d. date of manufacture;
   e. designated fabricator's approval stamp; and
   f. designation "SR" for product meeting sulfate-resistant concrete plan requirements (when applicable).
4. Storage and Shipment. Store precast units on a level surface. Do not ship units until design strength requirements have been met.

C. Excavation, Shaping, Bedding, and Backfill
1. Excavate, shape, bed, and backfill in accordance with Section 31 23 00 "Structural Excavation and Backfill". Immediate backfilling is permitted for all junction box, manhole, and inlet structures where joints consist of rubber boots, rubber gaskets, or bulk or preformed joint sealant. Take precautions in placing and compacting the backfill to avoid any movement of junction boxes, manholes, and inlets. Remove and replace junction boxes, manholes, and inlets damaged by the Contractor at no expense to the Department.

D. Junction Boxes, Manholes, and Inlets for Precast Concrete Pipe Storm Drains
   1. Construct junction boxes, manholes, and inlets for precast concrete pipe storm drains before completion of storm drain lines into or through the junction box, manhole, or inlet. Neatly cut all storm drains at the inside face of the walls of the junction box, manhole, or inlet.

E. Junction Boxes, Manholes, and Inlets for Box Storm Drains
   1. Place bases or risers of junction boxes, manholes, and inlets for box storm drains before or in conjunction with placement of the storm drain. Backfill the junction box, manhole, or inlet and storm drain as a whole.

F. Inverts
   1. Shape and route floor inverts passing out or through the junction box, manhole, or inlet as shown on the plans. Shape by adding and shaping mortar or concrete after the base is placed or by placing the required additional material with the base.

G. Finishing Complete Junction Boxes, Manholes, and Inlets
   1. Complete junction boxes, manholes, and inlets in accordance with the plans. Backfill to original ground elevation in accordance with Item 400, "Excavation and Backfill for Structures."

H. Finishing Stage I Construction
   1. Complete Stage I construction by constructing the walls to the elevations shown on the plans and backfilling to required elevations in accordance with Item 400, "Excavation and Backfill for Structures."

I. Stage II Construction
   1. Construct subgrade and base course or concrete pavement construction over Stage I junction box, manhole, or inlet construction unless otherwise approved. Excavate to expose the top of Stage I construction and complete the junction box, manhole or inlet in accordance with the plans and these Specifications, including backfill and cleaning of all debris from the bottom of the junction box, manhole, or inlet.

J. Inlet Units
   1. Install cast iron or steel inlet units in conjunction with the construction of concrete curb and gutter. Set the inlet units securely in position before placing concrete for curb and gutter. Form openings for the inlets and recesses in curb and gutter as shown on the plans. Place and thoroughly consolidate concrete for curb and gutter adjacent to inlets and around the inlet castings and formed openings and recesses without displacing the inlet units.

3.2 MEASUREMENT

A. All junction boxes, manholes, and inlets satisfactorily completed in accordance with the plans and specifications will be measured by each junction box, manhole, or inlet, complete, or by each junction box, manhole, or inlet completed to the stage of construction required by the plans.

END OF SECTION

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

PART 1 – GENERAL

1.1 GENERAL

A. This section specifies furnishing and installing new water mains including valves, valve boxes, flushing valves, blocking, fittings and other appurtenances.

1.2 RELATED WORK

A. Section 31 11 00 – Clearing and Grubbing
B. Section 31 23 33 – Trenching and Backfilling

1.3 REFERENCE STANDARD

A. Except as otherwise specified or shown, the workmanship, methods of installation, construction procedures and materials furnished will be in strict accordance with the following publications of the American Water Works Association (AWWA). Use the latest editions and any applicable amendments.
    1. Standard Specifications for Water Works Construction.
    2. Material Specifications for Water Works Construction.
B. Specific project general utility notes:
    1. All materials and construction procedures within the scope of this project shall be approved by the Project engineer or owner, and where applicable, the "American Water Works Association Standards," current edition.
    2. The locations and depths of existing utilities, including service laterals, and drainage structures shown on the plans are approximate only. The Contractor shall verify the exact location and depths of underground utilities at least 48 hours prior to construction whether shown on plans or not, and to protect the same during construction.
    3. No meter boxes to be set in driveways. Any meter boxes set in driveways will relocated at the contractor's expense.
    4. The Contractor shall be responsible for restoring to its original or better condition from damage done to existing fences, curbs, streets, driveways, landscaping and structures.
    5. The Contractor shall avoid cutting roots larger than one inch in diameter when excavating near existing trees. Excavation in vicinity of trees shall proceed with caution.
    6. No extra-payment shall be allowed for work called for on the plans but not included on the bid schedule. This incidental work will be required and shall be included under the pay item to which it relates.
    7. Contractor and/or Contractor's independently retained employee or structural design/geotechnical/safety/equipment consultant, if any, shall review these plans and available geotechnical information and the anticipated installation site(s) within the project work area in order to implement Contractor's trench excavation safety protection that complies with as a minimum, OSHA Standards for trench excavations. Specifically, Contractor and/or Contractor's independently retained employee or safety consultant shall implement a trench safety program in accordance with OSHA Standards governing the presence and activities of individuals working in and around trench excavation.
    8. A #10 AWG tracer wire shall be installed with all non-metallic gas and water lines. The wire shall be taped to the pipe every 20 feet, be continuous, and accessible above ground at all main valves and pad site hose bibs.
    9. All outside hose bibs shall have a hose connection vacuum breaker installed.

10. The existing abandon water mains are transite pipe ASC type.
11. All backflow devices shall be installed aboveground.
12. All valve boxes shall have a concrete pad installed around them.
13. All water valves shall be left hand open.
14. All fire hydrants shall be dry barrel type and will not be obstructed.

PART 2 – PRODUCT

2.1 MATERIALS

A. All materials provided for water distribution mains and appurtenances shall comply with the. AWWA Material Specifications for Water Works Construction.

2.2 POLYVINYL-CHLORIDE (PVC) PIPE

A. Provide PVC pipe as manufactured by Certain-teed, Johns-Manville, Clow, Gifford-Hill, Robintech, or approved equal. The pipe material shall conform to ASTM D-1784 and National Sanitation Foundation Standard No. 14 for a design stress of 2,000 psi. The pipe must also conform to quality control tests as described in ASTM 1599, ASTM 1598, ASTM 2152 and ASTM 2241.
B. For two-inch (2") water lines, the PVC shall conform to ASTM D-2241, SDR 21, Class 200 for a working pressure up to 200 psi.
C. For four-inch (4") and larger water lines, the PVC pipe shall conform to AWWA C-900, DR 18 Class 150 for a working pressure up to 150 psi.

2.3 DUCTILE IRON PIPE

A. Provide ductile iron pipe centrifugally cast in accordance with the latest revision of AWWA C-151 or AWWA C-115.
    1. Ductile iron pipe used with threaded or flanged connections shall be thickness Class 53 (minimum).
    2. Ductile iron pipe used with compression-type push-on connections shall be thickness Class 51 for four-inch (4") pipe and thickness Class 50 (minimum) for six-inch (6") and larger pipe.
B. Provide all pipe with joints of the type and size shown on construction drawings.
    1. Provide and install flanged connections in accordance with the latest revision of AWWA C-115.
    2. Provide and install push-on type connections in accordance with the latest revision of AWWA C-111.
C. The interior surfaces of all ductile iron pipes shall be cement mortar lined to standard thickness and sealed in accordance with the latest revision of AWWA C-104. The exterior surface of all buried ductile iron pipe shall be coated with coal tar or asphaltic base bituminous materials to a minimum dry thickness of 1 mil and wrapped with polyethylene encasement in accordance with the latest revision of AWWA C-105. Exterior surfaces of ductile iron pipe above ground shall be coated as outlined in the Section on Protection Coatings.

2.4 FITTINGS

A. For cast iron pipe fittings, furnish mechanical joint, Type III, or a boltless, gasketed joint such as Bell-Tite, Tyton or approved equal.
B. Provide factory-forged, steel pipe fittings four (4) inches through 24 inches conforming to AWWA C-208. Furnish long radius fittings for all bends. Bevel ends for field butt welding. Provide fittings with wall thickness equal to or greater than the wall thickness of the pipe to

which the fittings are to be welded. Insulation joints shall be installed where steel pipe is connected to any other type of water line.

C. For PVC pipe fittings and joints, provide Fluid-Tite by Certain-teed, Ring-Tite by Johns-Manville, or approved equal. The fittings shall conform to ASTM D-2467 and the joints shall conform to ASTM D-3139. The pipe material shall conform to ASTM D-1784 and National Sanitation Foundation Standard No. 14 for a design stress of 2,000 psi. The gasket material shall conform to ASTM F-477.

PART 3 – EXECUTION

3.1 STAKING

A. Water lines will be staked by Contractor.

3.2 SETTING VALVES, VALVE BOXES AND FLUSHING VALVES

A. Prior to installing valves or flushing valves, remove foreign matter from within the valves. Inspect the valves in open and closed position to verify that all parts are in satisfactory working condition.

B. Install valves, valve boxes and flushing valves where shown or as located by the Project Engineer or Owner's Representative. Set valves and flushing valves plumb and as detailed on the drawings. Center valve boxes on valves. Locate valves away from roads or streets. Carefully tamp earth around each valve box for a minimum radius of four (4) feet, or to undisturbed trench face if less than four (4) feet. Set flushing valves at such elevations that connecting pipe will not have less cover than distributing mains.

C. Place a concrete thrust block opposite pipe connections, set against the vertical face of the trench to prevent the valve from blowing off the line. If the character of the soil is such that the flushing valve cannot be securely wedged in this manner, provide bridle roads and rod collars of not less than 3/4-inch (3/4") stock protected by a coat of acid-resisting paint.

D. Place at least five (5) cubic feet of broken stone around the base of the flushing valve to insure drainage. Compact backfill thoroughly around the valve to grade line.

3.3 PIPE INSTALLATION

A. Use piping and materials for water mains of types specified, unless otherwise shown.

B. Do not lay pipe in water, or when trench or weather are unsuitable for work, except with permission of the project engineer. Keep water out of trench until joining is complete. When work is not in progress, close ends of pipe and fittings securely so that no trench water, earth or other substance will enter pipes or fittings.

C. Keep the inside of the pipe free from foreign matter during operations by plugging or other approved method.

D. Place pipe so that the full length of each section rests solidly upon the pipe bed, with recesses excavated to accommodate bells and joints. Take up and relay pipe when the grade or joint is disturbed after laying.

E. Locate no joints closer than nine (9) feet from sanitary sewer crossovers.

F. Where pipe ends are left for future connections install valves, plugs or caps, as shown.

G. Handle pipe and accessories so that all pipe placed in the trench is sound and undamaged. Take particular care not to injure pipe coating. Do not place other pipe or anything else inside the pipe or fitting after coating has been applied.

H. Cut neatly, using approved type mechanical cutter without damaging pipe. Use wheel cutters when practicable.

I. Before installation, inspect pipe for defects and tap with a light hammer to detect cracks. Replace sections of pipe found to be defective, damaged or unsound, before or after laying.

J. Regardless of the type of pipe being layed, provide six (6) inches of clean, coarse sand bedding in the bottom of the trench, the trench having previously been cut six (6) inches below grade. Provide and compact bedding prior to laying the pipe and making up the joints. After making up and inspecting joints, place clean, coarse sand backfill around the pipe, extending the full width of the trench and to a minimum compacted depth of six (6) inches over the top of the pipe to provide a compacted encasement surrounding the pipe. Take care that no dirt, clods or trench sides are allowed to fall on or to rest against the pipe prior to completion of the encasement.

K. Backfill the remainder of the trench utilizing select backfill material of optimum moisture content as follows:
   1. Open Areas: Above the pipe zone, deposit backfill in eight-inch (8") layers. Compact each layer to 90 percent (90%) TEX 113E Density. The top of backfill shall be built and compacted to the finished grade elevation at the trench.
   2. Pavement Sections: Above the pipe zone, deposit backfill in 8-inch (8") layers, each layer compacted to 95 percent (95%) TEX 113E Density. Place compacted soil material to within one foot (1') of proposed pavement surface at the trench.

L. Backfilling from the top of the conduit encasement to the finished surface may be done utilizing low strength fill at the option of the contractor.

M. Bury water lines 12 inches and smaller and flushing valve leads to a minimum depth of four (4) feet. Bury water lines 16 inches and larger to a minimum depth of five (5) feet.

N. Do not exceed pipe manufacturer's recommendations for deflections from straight line or grade as required by vertical curves, horizontal curves, or offsets. If alignment requires deflections in excess of these limitations, furnish special bends of sufficient number of shorter lengths of pipe to provide angular deflections within the limits set or approved.

O. After a length of pipe is placed in the trench, hole packing material for the joint around the bottom of the spigot so that packing will enter the bell as the pipe is pushed into position, or a rubber gasket may be inserted in the bell before pushing the pipe into place. Center the spigot on the bell and push the spigot into required alignment and position. Except where necessary in making connections with other lines, lay pipe with bells facing the direction at least two (2) lengths of pipe ahead of each joint, with packing installed and earth fill tamped alongside pipe, before joint is poured.

P. Install mechanical joints according to the recommendations of the manufacturer.

Q. Make slip-on joints according to the recommendations of the manufacturer.

R. If lubricant is required, it shall be non-toxic, it shall not support the growth of bacteria, and it shall not contribute taste and odor to water systems flushed with a chlorine solution for disinfection.

S. Thrust block. Anchor tees, elbows and plugs of water mains with concrete thrust blocks as shown. Place blocks so that the joints will be accessible for inspection and repair. Use concrete with 3,000 psi compressive strength.

T. Substitution. In lieu of thrust blocking on cast iron pipe, substitute push-on, locking-type joints. Provide joints such as LokTyton as manufactured by the United States Pipe and Foundry Company. Equip these joints with Lok-Tyton gaskets and pipe groove according to manufacturer's recommendations.

3.4 DISINFECTION

A. Disinfect each unit of the completed distribution system with chlorine before acceptance for domestic operation. Use not less than 100 parts of chlorine per million parts of water. Introduce chlorinating material to the water lines and distribution systems in an approved manner. If possible, flush lines thoroughly before introducing chlorinating materials. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is not greater than 1.0

part per million parts of water. Open and close valves in lines being disinfected several times during contact period.

3.5 TESTING

A. Test all new water lines hydrostatically. Conduct hydrostatic tests in the presence of the Civil Engineer, and in an approved manner. Reports shall be submitted to the project engineer. Apply test pressure of 125 psi, and maintain this pressure for a minimum of eight (8) hours. Do not permit line losses during the test to exceed the limits set forth in the table titled "Maximum Allowable Leakage" provided herein. Regardless of the rate of line loss, repair observed leaks. Replace faulty or defective materials until successful passage of the hydrostatic test. Provide all pumps, gages, meters and other equipment necessary for performance of the tests.

MAXIMUM ALLOWABLE LEAKAGE							
Gallons Per Hour Per 1000 Feet of Main							
Type of Pipe and Joint							
Pipe Size (Inches)			C.I. Lead Jt.		D.I. or C-900		Push-onA/C Collars
2			1.58		0.34		-
4			3.16		0.68		-
6			4.74		1.01		1.29
8			6.31		1.35		1.72
12			9.47		2.02		2.58
16			12.63		2.69		3.44
20			15.78		3.36		-
24			18.94		4.03		-
30			23.67		5.40		-

B. Where practicable, pipe lines shall be tested in lengths between line-valves or plugs of no more than 1,500 feet.

C. Bacteriological Tests: After disinfecting and flushing mains, obtain the service of an approved laboratory to gather representative samples and conduct bacteriological tests. Test results must meet Texas Department of Health requirements. Reports shall be submitted to the project engineer. Make all necessary corrections, repeat sterilization and flushing procedures, and retest affected lines if test results are not acceptable. Repeat this procedure until satisfactory results are obtained.

END OF SECTION

SECTION 33 11 16

SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 – GENERAL

1.1 PROVISIONS

A. Requirements of the Conditions of the Contract apply to all work under this section.

B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

1.2 DESCRIPTION

A. Work covered by this Section includes all materials, labor, services, equipment, licenses, taxes, other items, and appliances necessary for the execution, installation and completion of all work specified herein and/or shown on the drawing.

B. The Work described in this section of the specifications includes, but is not limited to, the following:

   a. Off-site and on-site water line construction with necessary water main materials, fittings, connections and accessories.

1.3 RELATED WORK

A. The following items of related work are specified and included in other sections of these specifications:

   1. Section 31 22 00 - Grading
   2. Section 31 23 00 - Excavation
   3. Section 31 23 33 - Trenching, and Backfilling
   4. Section 33 31 13 – Site Sanitary Sewage Piping

1.4 REFERENCE STANDARDS

A. Local governing agency's Standard Specifications (LGASS)

1.5 SPECIAL CASES

A. For projects where the local governing agency does not have standard specifications, please defer to the International Plumbing Code and design as shown on the plans.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Water Line Pipe: LGASS.
B. Water Service Lines: LGASS.
C. Ductile Iron Water Pipe and Fitting: LGASS.
D. Vaults: ASTM 76.
E. Portland Cement Concrete: LGASS.

PART 3 – EXECUTION

3.1 TRENCH EXCAVATION, BACKFILLING AND COMPACTION

A. Excavation: LGASS.
B. Foundation, Bedding, Backfilling and Compaction: LGASS.
C. Pavement Replacement and Surface Restoration: LGASS.

3.2 WATER LINE CONSTRUCTION

A. Cathodic protection shall be installed on all buried metallic gas, water, fire protection, pipes, valves, fittings, hydrants, building risers per I.A.W. Air Force AFI 32-1054.
B. A #10 AWG tracer wire shall be installed with all non-metallic gas and water lines. The wire shall be taped to the pipe every 20 feet, be continuous, and accessible above ground at all main valves and pad site hose bibs.
C. Installation of Water Transmission, Collector and Distribution Lines: LGASS.
D. Installation of Water Service Lines: LGASS.
E. Valves: LGASS.
F. Fire Hydrants: LGASS.
G. Connection to Existing Mains: LGASS.
H. Meter Service Connections: LGASS.
I. Couplings, Joints, Gaskets and Flanges: LGASS.
J. Blocking: LGASS.
K. Testing: LGASS.
L. Pavement and Surfacing Replacement: LGASS.
M. Disinfecting Water Mains: LGASS.

END OF SECTION

SECTION 33 31 13

SITE SANITARY UTILITY SEWAGE PIPING

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item shall govern the furnishing, installation and jointing of sanitary sewer pipe of the size and type specified by the project plans and specifications.
B. All sanitary sewer mains shall be constructed in accordance with the specifications herein outlined and in conformity with the required lines, grades and details shown on the plans. Successful passage of the air test shall be required when specified by the plans.

PART 2 – PRODUCTS

2.1 MATERIALS FOR SANITARY SEWER PIPE

A. All gravity sanitary sewer pipe and fittings shall be SDR 26 PVC or as denoted on the plans.
B. When flexible pipe is used, select initial backfill shall be clean coarse sand with no particles larger than a No. 10 sieve.
C. Any flexible conduit having a deflection of the inside diameter greater than five percent (5%) after installation will not be accepted. A GO, NO-GO Deflection Testing Mandrell built in accordance with the detail drawing as shown on the detail sheet, shall be furnished at the Contractor's expense and shall be used in testing pipe deflection for acceptance.
D. The working room for flexible pipe shall be a minimum of six inches (6") and a maximum of twelve inches (12") from each side of the pipe to the face of the trench walls.
E. Where gravity or force main sewers are constructed in the vicinity of water mains, the requirements of the "Rules and Regulations for public Water Systems" of the Texas Department of Health, Water Hygiene Division, adopted 1978, shall be met.
F. All sanitary sewer pipe and fittings and shall be accompanied by a certificate of compliance to these specifications prepared by an independent testing laboratory and signed by a Registered Professional Engineer.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Pipe twenty four inches (24") and smaller shall rest on an undisturbed foundation, continuously, throughout its length, true to line and grade. When bell and spigot pipe is used, the position of the pipe bells shall be cross excavated just enough to admit the pipe bells without bearing.
B. Subgrade filler: When laying pipe in unstable materials such as quicksand, muck or other unstable materials, the contractor shall, when directed by the Project Engineer or Owner's Representative, underexcavate and remove existing unstable materials or rock, and replace with subgrade filler material in accordance with the requirements of Section No. 31 23 23, "Subgrade Fill".
C. Pipe Laying: The Contractor shall be required to commence construction and laying of pipe at the downstream end of the sanitary sewer outfall line and proceed non-stop in a forward upstream direction.
D. No pipe shall be laid within ten feet (10') of any point where excavation is in progress. Pipe laying shall proceed upgrade with the tongue or spigot pointing in the direction of flow. Pipe shall be lowered into the trench without disturbing the prepared foundation or the trench sides.

The drilling of lifting holes in the field will not be permitted. Pipe shall be installed by means of a concentric pressure being applied to the pipe with "come-alongs". Pulling or pushing a joint of pipe in place by using a crane, bulldozer, or backhoe will not be permitted. Pipe shall be pulled home in a straight line with all parts of the pipe on line and grade at all times. No side movement or up and down movement of the pipe will be permitted during or after the pulling operation. Should coupled joints of pipe be out of line or off grade, they shall be removed one joint at a time and brought to the proper line and grade. The lifting or moving of several joints of coupled pipe at time to close a partially open joint or to fine grade one time to close a partially open joint or to fine grade under laid joints of pipe will not be permitted.

E. No pipe shall be installed in tunnels except as provided on the plans. No horizontal or vertical curves shall be permitted, except as authorized by the Project Engineer or Owner's Representative. The minimum radius for the type sewer pipe used shall be as recommended by the manufacturer or greater and must be approved by the Project Engineer or Owner's Representative.

F. Before leaving the work unattended, the upper ends of all pipelines shall be securely closed with a tight fitting plug or closure. The interior of laid pipe shall be kept free from dirt, silt, gravel or foreign material at all times.

END OF SECTION