LAKE HAVASU CITY

INVITATION TO BID

CONTRACT DOCUMENTS

AND

TECHNICAL SPECIFICATIONS

WATER TREATMENT PLANT IMPROVEMENTS PROJECT

B26-PW-108025-500707

REVISED 9/29/2025

LAKE HAVASU CITY

CONTRACT DOCUMENTS
VOLUME 1

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The following specifications are contained within this Invitation For Bids:

LHC 1210 - MEASUREMENT AND PAYMENT

The remaining applicable specifications can be accessed at:

https://www.lhcaz.gov/public-works/engineering

Please scroll down to the bottom of the webpage and notice there are clickable page numbers to access all specification documents.

SECTION 00020

NOTICE INVITING BIDS

Lake Havasu City

PROJECT NO.: **B26-PW-108025-500707**

PROJECT NAME: **Water Treatment Plant Improvements Project**

PRE-BID MEETING: A **NON-MANDATORY Pre-Bid Meeting** will be held at the Public Works Administration Building, 900 London Bridge Road Avenue, Lake Havasu City, AZ at 11:00 am, Arizona Time, on October 23, 2025.

BID DUE DATE: **November 5, 2025**

BID DUE TIME: **3:00 p.m., ARIZONA TIME**

PROJECT DESCRIPTION:

This project consists of replacing an existing gas Chlorination system with a new liquid chlorination system at the Lake Havasu City Water Treatment Plant. This includes constructing a new airconditioned masonry building to house the necessary equipment.

QUESTIONS: All questions that arise relating to this solicitation shall be directed in writing to purchasing@lhcaz.gov with a copy to hartj@lhcaz.gov . To be considered, written inquiries shall be received at the above-referenced email address by September 22, 2025, 3:00 p.m. Arizona Time. Inquiries received will then be answered in an Addendum.

Sealed bids for the project specified will be received by the **City Clerk's Office, 2330 N. McCulloch Boulevard, Lake Havasu City, Arizona, 86403** until the time and date stated. **Bids received by the correct time and date will be opened and read aloud immediately thereafter in Room 109 of Lake Havasu City Hall.** Public openings may be attended virtually by accessing the following video conferencing system:

To join the meeting on a computer or mobile phone:
https://tinyurl.com/3f94b2ww
Meeting ID: 270 366 031 956
Passcode: jcVbxK

Join with a video conferencing device
160264325@teams.bjn.vc
Video Conference ID: 112 219 692 0

Bids must be clearly addressed to the City Clerk's Office, 2330 McCulloch Blvd. N, Lake Havasu City, Arizona, 86403, and received no later than the exact time and date indicated above. Late bids will not be considered under any circumstances.

Bids must be submitted in a sealed envelope with the Project Number and the bidder's name and address clearly indicated on the envelope. All bids must be completed in ink or typewritten on a form to be obtained from the specifications and a complete Invitation for Bid returned along with the offer no later than the time and date cited above.

Bidders interested in taking advantage of the streamlined e-Bid and e-Bond process shall submit their bids electronically via the City's DemandStar Network at https://www.demandstar.com/app/buyers/bids/496803. Paper bids and paper bid bonds will continue to be accepted. Bidders submitting e-Bids will be required to scan and enclose their paper bid bond/cashier's check with their electronic bid submission. The apparent low bidder shall submit their original bid bond/cashier's check within three (3) business days following the Bid opening.

Bid documents and specifications are available on Lake Havasu City's website at www.lhcaz.gov or on DemandStar at www.demandstar.com. For documents obtained outside of DemandStar please contact purchasing@lhcaz.gov to be added to the planholders' list.

For technical information, contact Jason Hart, Project Manager, at hartj@lhcaz.gov with a copy to purchasing@lhcaz.gov .

BONDS:

Bid Bond:	10%
Labor and Material Bond:	100%
Faithful Performance Bond:	100%

Project Completion Date: 180 calendar days after Notice to Proceed.

Lake Havasu City reserves the right to accept or reject any or all bids or any part thereof and waive informalities deemed in the best interest of the City.

Pursuant to the Americans with Disabilities Act (ADA), Lake Havasu City endeavors to ensure the accessibility of all of its programs, facilities and services to all persons with disabilities. If you need an accommodation for this meeting, please contact the City Clerk's office at (928) 453-4142 at least 24 hours prior to the meeting so that an accommodation may be arranged.

Publication Dates: TODAY'S NEWS HERALD – October 8, 2025, and October 15, 2025

ARIZONA BUSINESS GAZETTE – October 9, 2025, and October 16, 2025

** END OF SECTION **

SECTION 00040

INTENT TO BID NOTIFICATION

ITB NO.: B26-PW-108025-500707

ITB TITLE: Water Treatment Plant Improvement Project

CLOSING DATE & TIME: November 5, 2025 at 3:00 PM, Arizona Time

LETTER OF INTENT TO BID SUBMITTAL

This is notification that it is our present intent to submit a bid in response to the above referenced ITB. Please add our company to your planholders list.

The individual to whom all information regarding this ITB should be transmitted is:

Company Name: _____

Contact Name: _____

Street Address: _____

City, State, & Zip: _____

Phone Number: Fax Number: _____

E-Mail Address: _____

Submit this Letter of Intent by the deadline for requests for clarification and protests, which must be physically received by **October 8, 2025 at 3:00 p.m., Arizona Time.**

Clarification/Protest/Question/Letter of Intent to Bid
ITB No.: B25-PW-108025-500707 Lake Havasu City
Administrative Services Department, Procurement
Email to: purchasing@lhcaz.gov

** END OF SECTION **

SECTION 00100

INFORMATION FOR BIDDERS

1. RECEIPT AND OPENING OF BIDS

The City of Lake Havasu City, Arizona, (hereinafter called the "Owner") invites Bids on the form attached hereto**.** All blanks must be appropriately filled in. The Bidder shall also complete and submit a form listing proposed subcontractors as enclosed herein. Any subcontractors proposed to be used on the project but not listed on this form shall not be considered when evaluating the Contractor's qualifications and ability to perform the work. Bids **Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707** will be received by the **City Clerk's office, 2330 N. McCulloch Boulevard, Lake Havasu City, Arizona 86403 no later than 3:00 P.M., Arizona Time, November 5, 2025,** where said Bids will be publicly opened and virtually read aloud immediately thereafter in the Room 109 of Lake Havasu City Hall.

The Owner may consider informal any Bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all Bids. Any Bid may be withdrawn prior to the above scheduled time for the opening of Bids or authorized postponement thereof. Any Bid received after the time and date specified shall not be considered. No Bidder may withdraw a Bid within ninety (90) days after the actual date of the opening thereof.

Bidders interested in taking advantage of the streamlined e-Bid and e-Bond process shall submit their bids electronically via the City's DemandStar Network at https://www.demandstar.com/app/buyers/bids//details. Paper bids and paper bid bonds will continue to be accepted.

Bidders submitting e-Bids will be required to scan and enclose their paper bid bond/cashier's check with their electronic bid submission. The apparent low bidder shall submit their original bid bond/cashier's check within three (3) business days following the Bid opening.

2. PREPARATION OF BID

Each Bid must be submitted on the prescribed Form. Each Document must be submitted with an original signature of the Bidder, as well as all witnesses indicated therein. All blank spaces for Bid prices must be filled in, in ink or typewritten, in both words and figures.

Each Bid must be submitted in a sealed envelope bearing on the outside the name of the Bidder, the Bidder's address, and the name and number of the project for which the Bid is submitted. If forwarded by mail, the sealed envelope containing the Bid must be enclosed in another envelope addressed as specified in the Bid form.

3. FACSIMILE BIDS OR MODIFICATIONS

No facsimile ("FAX") Bids or bid modifications will be accepted. Any modifications to the Bid shall be made by an authorized representative of the bidding company in person.

4. QUALIFICATIONS OF BIDDER

The Owner may make such investigations as he deems necessary to determine the qualifications of and the ability of the Bidder to perform the Work, and the Bidder shall furnish the Owner such information and data for this purpose as the Owner may request. The Owner may request that the Bidder provide a list of key people for the project with their related work experience.

The Owner reserves the right to reject any Bid if the evidence submitted by or investigation of such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein in a timely manner. Conditional Bids will not be accepted.

All Bidders and listed subcontractors must be valid Arizona Licensed Contractors at the time of Bidding, approved by the Arizona State Registrar of Contractors to do the type and amount of work specified in these documents. In accordance with the Arizona State Registrar of Contractors, the Bidder must possess a minimum of a Class A Arizona Contractor's License to perform the type and amount of work specified in these documents. **Failure of any bidder to possess all contractors' licenses as listed in the bid packet, at the time of bidding, shall result in the bid being considered non-responsive and not in substantial compliance, and any such bid shall not be considered.** Refer to Section 00420, page 3, item 13.

5. ARITHMETIC DISCREPANCIES IN THE BID

A. For the purpose of the evaluation of Bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the Bid Schedule as submitted by Bidders:

1. Obviously misplaced decimal points will be corrected;
2. In case of discrepancy between unit price and extended price, the unit price will govern;
3. Apparent errors in extension of unit prices will be corrected;
4. Apparent errors in addition of lump sums and extended prices will be corrected; and
5. In case of discrepancy between words and figures in unit prices, the amount shown in words shall govern.

B. For the purpose of Bid evaluation, the Owner will evaluate the bids on the basis of the unit prices, extensions, and totals arrived at by resolution of arithmetic discrepancies as provided above.

6. INCOMPLETE BIDS

Failure to submit a Bid on all items in the Schedule will result in an incomplete Bid and the Bid may be rejected. **UNIT OR LUMP SUM PRICES MUST BE SHOWN FOR EACH BID ITEM WITHIN THE SCHEDULE.**

NOTE: FAILURE TO INDICATE UNIT OR LUMP SUM PRICES IN THE APPROPRIATE COLUMN, WITH THE EXTENSION OF THE PRICES IN THE FAR RIGHT COLUMN, WILL CAUSE THE BID TO BE "NON-RESPONSIVE".

All forms indicated in the Bid Proposal, Section 00300, must be completely filled out, executed, and submitted with the Bid. Failure to do so will render the bid "non-responsive" and the bid will not be accepted.

7. BID SECURITY

Each Bid must be accompanied by certified check, cashier's check, or a Bid Bond prepared on the form attached hereto or on a similar form acceptable to the Owner, duly executed by the Bidder as principal and having as surety thereon a surety company approved by the Owner, in the amount of ten percent (10%) of the Bid. Bid Bonds shall be valid for at least ninety (90) days after the date of the receipt of Bids. Such cash, check or Bid Bond will be returned to all except the three (3) lowest Bidders within fifteen (15) business days after the opening of Bids. The remaining checks, or Bid Bonds will be returned promptly after the Owner and the accepted Bidder have executed the Contract, or if no award has been made within ninety (90) days after the date of the opening of Bids, upon demand of the Bidder at any time thereafter, so long as he has not been notified of the acceptance of his Bid.

8. LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT

The successful Bidder, upon his failure or refusal to execute and deliver the Contract, Bonds, and certificates required within ten (10) calendar days from the date of the Notice of Award, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the difference between his bid and the amount of the contract actually entered into with another party should he not enter into a contract at the bid price and provide the required payment and performance bonds and certificates of insurance. Liquidated damages for failure to enter into the contract shall not exceed the amount of the Bid Bond.

9. SECURITY FOR FAITHFUL PERFORMANCE AND PAYMENT

Simultaneously with his delivery of the executed Contract, the Bidder shall furnish **on the forms provided herein**, in 100% of the amount of this Contract, 1) a surety bond as security for faithful performance of this Contract, and 2) a surety bond as security for the payment of all persons performing labor on the project under this Contract and persons furnishing materials in connection with this Contract, and 3) a listing of all subcontractors who will be performing or providing more than one-half percent (0.50%) of the contract work, as specified in the General Conditions included herein. The surety on such bond or bonds shall be a duly authorized surety company satisfactory to the Owner, listed on the Treasury Department's most current list (Circular 570 as amended), and authorized to transact business in the State of Arizona.

10. POWER OF ATTORNEY

Attorneys-in-fact who sign Bid Bonds or Contract bonds must file with each bond a certified

and effectively dated copy of their power-of-attorney.

11. LAWS AND REGULATIONS

The Bidder's attention is directed to the fact that all applicable Federal Laws, State Laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

12. METHOD OF AWARD

A. The City will award the Contract on the basis of the Bid or Bids most advantageous to the City. In determining whether a Bid is most advantageous, in addition to price, the City may consider the following:

1. The ability, capacity, and skill of the Bidder to perform the Contract or provide the service indicated;
2. Whether the Bidder can perform the Contract or provide the service promptly, and within the time specified without delay or interference;
3. The character, integrity, reputation, judgment, experience, and efficiency of the Bidder;
4. The quality of performance on previous contracts;
5. The previous compliance with laws and ordinances by the Bidder;
6. The financial responsibility of the Bidder to perform under the Contract or provide the service;
7. The limitations of any license the Bidder may be required to possess;
8. The quality, availability, and adaptability of the product or service;
9. The ability of the Bidder to provide future maintenance and/or service;
10. The number and scope of any conditions attached to the Bid; and;
11. The life cycle, maintenance, and performance of the equipment or product being offered.

13. OBLIGATION OF THE BIDDER

At the time of the opening of Bids, each Bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Plans and Contract documents (including all Addenda, if applicable). The failure or omission of the Bidder to examine any form, instrument or document, or site changes due to natural causes, shall in no way relieve any Bidder from any obligation in respect to his Bid. Site changes due to natural causes prior to Bid opening shall not be cause for Bid alteration or withdrawal.

14. TIME OF COMPLETION AND LIQUIDATED DAMAGES

The Bidder must agree to commence work on or before a date to be specified in a written "Notice to Proceed" from the Owner, and to complete the work within **180 calendar days** of the date of the Notice to Proceed.

The Bidder further agrees to pay as liquidated damages, the sum indicated in the following Schedule of Liquidated Damages for each consecutive calendar day thereafter, plus any additional costs incurred by the Engineer as provided in Section 17 of the General Conditions, that the Contract remains incomplete. For the purposes of determining the Liquidated Damages for the project, the Original Contract Amount shall be that which is included in the Contract between the Owner and the Contractor for the project.

SCHEDULE OF LIQUIDATED DAMAGES		
Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day or Fixed Rate
0	25,000	210
25,000	50,000	250
50,000	100,000	280
100,000	500,000	430
500,000	1,000,000	570
1,000,000	2,000,000	710
From More Than	To and Including	Calendar Day or Fixed Rate
2,000,000	5,000,000	1,070
5,000,000	10,000,000	1,420
10,000,000	---0---	1,780

15. CONDITIONS OF WORK

Each Bidder must inform himself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder of his obligation to furnish all material and labor necessary to carry out the provisions of his Contract. Insofar as possible, the Contractor, in carrying out his work, must employ such methods or means as will not cause any interruption of or interference with the work of any other Contractor.

16. ADDENDA AND INTERPRETATIONS

All questions that arise relating to this solicitation shall be directed in writing to: purchasing@lhcaz.gov with a copy to engineeringinfo@lhcaz.gov.

Administrative Services Department, Procurement Division
Lake Havasu City
2330 McCulloch Blvd. North
Lake Havasu City, AZ 86403

To be considered, written inquiries shall be received by the above-referenced contact by **October 27, 2025, 3:00 p.m. Arizona Time**. Inquiries received will then be answered in an Addendum. Any and all such interpretations and any supplemental instructions will be in the form of written Addenda to the Specifications which, if issued, will be available to all prospective Bidders, not later than five (5) calendar days prior to the date fixed for the opening of Bids. Failure of any Bidder to incorporate any such Addendum or interpretation shall not relieve such Bidder from any obligation under his/her Bid as submitted. All Addenda so issued shall become part of the Contract documents.

No informal contact initiated by offerors on this solicitation will be allowed with members of City staff from the date of distribution of this solicitation until after the closing date and time for the submissions of quotations. All questions or issues related to this solicitation shall be submitted in writing.

17. CONFLICT OF INTEREST

Pursuant to A.R.S. Section 38-511, this Contract is subject to cancellation by Buyer if any person significantly involved initiating, negotiating, securing, drafting or creating the Contract on behalf of Lake Havasu City is, at any time while the Contract is in effect, an employee of any other party to the Contract in any capacity or a consultant to any other party of the Contract with respect to the subject matter of the Contract.

18. NO COLLUSION

The bidder will be required to complete, notarize and submit as part of this bid package the "No Collusion Affidavit" form, as attached herein. Failure of the bidder to submit a properly executed affidavit may be grounds for rejection of the bid.

19. EMPLOYMENT ELIGIBILITY VERIFICATION

The bidder will be required to complete, notarize and submit as part of this bid package the "Employer Verification of Employment Eligibility" form, as attached herein. Failure of the bidder to submit a properly executed verification of eligibility form may be grounds for rejection of the bid.

20. EXAMINATION OF THE PLANS AND SPECIFICATIONS

Each Bid shall be made in accordance with the Plans and Specifications which may be examined at the following locations:

A. Lake Havasu City, 2330 N. McCulloch Boulevard, Lake Havasu City, AZ 86403, 928.855.2116

B. Dodge Data & Analytics, 3315 Central Avenue, Hot Springs, AR, 71913,

871.375.2946, FAX 501.625.3544, www.construction.com, dodge.bidding@construction.com

C. Colorado River Building Industry Association, 2182 McCulloch Blvd, Suite 3, Lake Havasu City AZ 86403, 928.453.7755, FAX 928.453.3175, www.crbia.org, frontdesk@criba.org

D. Northern AZ Home Builders, 1500 E. Cedar Avenue, Suite 86, Flagstaff AZ 86004, 928.779.3071, FAX 928.779.4211, www.nazba.org, info@nazba.org

E. Performance Graphics Blueprinting, 4140 Lynn Drive, Suite 107, Fort Mohave, AZ, 86426, 928.763.6860, FAX 928.763.6835, prints@pgblueprinting.net

F. Construction Market Data, 30 Technology Parkway South, Suite 500, Norcross, GA 30092-2912, 800.876.4045, FAX 800.303.8629, www.cmdgroup.com, projects@cmdgroup.com

G. ISqFt, 3301 N 24th Street, Phoenix, AZ, 85016, 800.364.2059, FAX 800.792.7508, www.isqft.com, arizonaplanroom@isqft.com

H. Integrated Digital Technologies, LLC, 4633 E Broadway Blvd., Tucson, AZ 85711, PO Box 13086, Tucson AZ,85732, 520.319.0988, FAX, 520.319.1430,www.contractorsplanroom.com, content@idtplans.com

I. Yuma/Southwest Contractors Association, 350 W. 16th Street, Suite 207, Yuma, AZ 85364, Phone: 928-539-9035, Fax: 928-539-9036, www.yswca.com, plans@yswca.com

J. Arizona Builders Exchange, 1700 N. McClintock Drive, Tempe, AZ, 85281, (480) 227-2620, www.azbex.com, rkettenhofen@azbex.com

K. Construction Reports.com, 4110 N Scottsdale Road, Suite 335, Scottsdale, AZ, 85251, 480.994.0020, FAX 480.994.0030, www.constructionreports.com, jess@constructionreports.com

L. Construction Reporter, 1609 2nd Street NW, Albuquerque, NM, 87102, 505.243.9793, FAX 505.242.4758, www.constructionreporter.com, jane@constructionreporter.com

M. PlanRoom Central at A&E Reprographics, 1030 Sandretto Drive, Suite F, Prescott, AZ, 86305, 928.442.9116, www.a-erepro.com, planroom1@a-erepro.com

N. Shirley's Plan Service, 425 S. Plumer Ave, Tucson, AZ, 85719, 520.791.7436, FAX 520.882.9208, www.shirleysplanservice.com, bids@shirleysplanservice.com

O. Construction Notebook Nevada, 3131 Meade Ave, Suite B, Las Vegas, NV, 89102-7885, 702.876.8660, FAX 702.876.5683, www.constructionnotebook.com

P. The Blue Book Building & Construction Network, Jefferson Valley, NY 10535, 800.431.2584, www.thebluebook.com, info@thebluebook.com, tdizon@mail.thebluebook.com

Q. Integrated Marketing Systems (IMS), 945 Hornblend Street, Suite G, San Diego, CA 92109, 888.467.3151, FAX 858.490.8811, www.imsinfo.com , ims@imsinfo.com

** END OF SECTION **

SECTION 00300
BID PROPOSAL

Lake Havasu City, Arizona

The undersigned, as bidder, declares that we have received and examined the documents entitled " **Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707**" and will contract with the Owner, on the form of Contract provided herewith, to do everything required for the fulfillment of the contract for the construction of the **Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707** at the prices and on the terms and conditions herein contained.

We agree that the Contract Documents include Volumes I and II of the Contract Documents as well as the referenced documents.

We agree that the following shall form a part of this proposal and are included herein as our submittal:

		Enclosed
Section	**Title**	✓
00300	**Bid Proposal**	___
00310	**Bid Schedule**	___
00400	**Arizona Statutory Bid Bond**	___
00420	**Bidder's Statement of Qualifications**	___
00430	**Affidavit of Contractor Certifying That There Was No Collusion In Bidding For Contract**	___
00450	**Hazard Communication Program**	___
00460	**Employment Eligibility Verification**	___

We acknowledge that addenda numbers _____ through _____ have been received and have been examined as part of the Contract Documents.

We certify that our proposal is genuine, and not sham or collusive, nor made in the interest or behalf of any undisclosed person, organization, or corporation, and that we have not directly or indirectly induced or solicited any other bidder to put in a sham bid, or directly or indirectly inducted or solicited any other potential bidder to refrain from bidding, and that we have not in any manner sought by collusion to secure an advantage over any other bidder.

The bidder agrees that this Bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled closing time for receiving Bids.

Upon receipt of written notice of the acceptance of this bid, Bidder shall execute the formal Contract attached within 10 days and deliver a Performance Bond, Payment Bond, and Certificates of Insurance as required by Paragraph 25 of the General Conditions and the Special Provisions.

We hereby declare that we have visited the site and have carefully examined the Contract Documents relating to the work covered by the above bid or bids.

Enclosed herewith is a certified or cashier's check or bid bond, payable to Lake Havasu City, Arizona, in the amount of ten percent (10%) of the total bid. This check or bond is submitted as a guarantee that we will enter into a Contract, and furnish the required bonds in the event a contract is awarded us. The bid security attached, without endorsement, is to become the property of Lake Havasu City, Arizona, in the event the Contract and Bonds are not executed within the time set forth, as liquidated damages for delay and additional work caused thereby.

We understand that Lake Havasu City, Arizona reserves the right to reject any and/or all bids, or to waive any informalities in any bid, deemed by them to be for the best interests of Lake Havasu City, Arizona.

Dated in _____ this _____ day of _____,___.

Respectfully Submitted By:

By: _____

Title: _____

Name of Firm:_____

Address: _____

Phone: _____ FAX: _____

Email Address: _____

Seal - If bid by a Corporation:

Arizona Contractor's License No.: _____Type: _____

Federal Tax ID No.:_____

** END OF SECTION **

BID SCHEDULE
LAKE HAVASU CITY

Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707

Lake Havasu City Council
Lake Havasu City
2330 N. McCulloch Boulevard
Lake Havasu City, AZ 86403

The City Council:

Pursuant to request for bids to be opened the 16th of April, 2025, at 3:00 P.M., Arizona Time, at Room 109 of Lake Havasu City Hall, for the above project, the Contractor proposes to complete work, including furnishing all labor and materials, per the Specifications and Plans at the Following prices.

This Schedule of Items and Prices shall be completed in ink or typed by the Bidding Contractor. In case of discrepancy between the word and figure amount description, the word description shall control extensions.

Prices must be entered for each item and the appropriate subtotal and total blank shall be filled out. Bid prices shall include sales tax and all other applicable taxes and fees.

Bidder agrees to perform all the necessary work to complete the **Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707**

SECTION 0310

BID SCHEDULE - Water Treatment Plant, Project No. B26-PW-108025-500707

ITEM NO.	DESCRIPTION	EST QTY	UNIT OF MEASURE	UNIT PRICE (*1) (WORD)	UNIT PRICE (FIGURE)	ITEM TOTAL (*2) COSTS
BASE BID						
1	Mobilization/Demobilization, Bonds & Insurance	1	L.S.		$	$
2	SWPP Plan & Implementation	1	L.S.		$	$
3	Contractor Quality Control	1	L.S.		$	$
4	Construction Staking	1	L.S.		$	$
5	General Civil Improvements	1	L.S.		$	$
6	Demolition of Existing Structures and Chlorine System	1	L.S.		$	$
7	Liquid Chlorine Disinfection System	1	L.S.		$	$
8	Chemical Building	1	L.S.		$	$
9	Force Account	1	L.S.	One Hundred Thousand Dollars	$100,000.00	$100,000.00
	TOTAL BID(*3) + FORCE ACCOUNT				$	$

Above line items and totals shall include all work shown on the plans and specified herein, including taxes, insurance and bonding.

*1 The "Unit Price" column shall indicate unit or lump sum prices for each bit item and shall be indicated in written and numerical form.
*2 The "Item Total Costs" column shall indicate the extension of the unit prices, which is obtained by multiplying the "Estimated Quantity" column by the "Unit Price"
*3 The "Bid Total" amount shall be the sum of all costs listed in the "Item Total Costs" column.

The unit prices for **Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707** shall include all labor, materials, water disposal, bailing, shoring, removal, disposal, overhead, profit, insurance, and all other related costs and work to cover the finished work of the several kinds called for. Changes in the Contract shall be processed in accordance with Paragraph 16 of the General Conditions.

Bidder understands that the Owner reserves the right to reject any or all Bids, or portions thereof, and to waive any informalities in the bidding.

The Bidder agrees that this Bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled closing time for receiving Bids.

Upon receipt of written notice of the acceptance of this Bid, Bidder shall execute the formal Contract attached within 10 days and deliver a Performance Bond, Payment Bond, and Certificates of Insurance as required by Paragraph 25 of the General Conditions and the Special Provisions.

The Bid security attached in the sum of $_____ is to become the property of the Owner in the event the Contract and Bond(s) are not executed and provided within the time above set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

Bidder hereby acknowledges receipt of the following Addenda: ___, ___, ___.

RESPECTFULLY SUBMITTED BY:

BY: _____

TITLE: _____

FIRM: _____

ADDRESS: _____

_____

PHONE: _____FAX_____

EMAIL: _____

Seal - if Bid by a corporation

AZ Contractor's License No:_____Type_____

** END OF SECTION **

SECTION 00400

ARIZONA STATUTORY BID BOND

PURSUANT TO TITLES 28, 34 AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must not be less than 10% of the bid amount)

KNOW ALL MEN BY THESE PRESENTS:

That, _____(hereinafter "Principal"), as Principal, and _____, (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____, with its principal offices in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona, (hereinafter "Obligee"), as Obligee, in the amount of Ten Percent (10%) of the amount of the bid of Principal, submitted by Principal to the Obligee for the work described below, for the payment of which sum, the Principal and Surety bind themselves, and their heirs, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for

Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707

NOW, THEREFORE, if the Obligee shall accept the proposal of the Principal and the Principal shall enter into a contract with the Obligee in accordance with the terms of the proposal and give the bonds and certificates of insurance as specified in the standard specifications with good and sufficient surety for the faithful performance of the contract and for the prompt payment of labor and materials furnished in the prosecution of the contract, or in the event of the failure of the Principal to enter into the contract and give the bonds and certificates of insurance, if the Principal pays to the Obligee the difference not to exceed the penalty of the bond between the amount specified in the proposal and such larger amount for which the Obligee may in good faith contract with another party to perform the work covered by the proposal then this obligation is void. Otherwise it remains in full force and effect provided, however, that this bond is executed pursuant to the provisions of Section 34-201, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of that section to the extent as if it were copied at length herein.

Witness our hands this ___day of_____, _____.

PRINCIPAL SEAL	SURETY SEAL
By: _____	By: _____
Principal	Attorney-in-Fact
Its: _____	_____
Principal's Title	Agency of Record
	_____
	Agency Address

SECTION 00420
BIDDER'S STATEMENT OF QUALIFICATIONS

The Undersigned certifies the truth and correctness of all statements and of all answers to questions made hereinafter.

SUBMITTED TO: Lake Havasu City, Arizona
2330 N. McCulloch Boulevard
Lake Havasu City, AZ 86403

SUBMITTED BY: NAME:_____

ADDRESS:_____

PRINCIPAL OFFICE: _____

[ ] Corporation
[ ] Partnership
[ ] Individual
[ ] Joint Venture
[ ] Other

(NOTE: Attach separate sheets as required)

1. How many years has your organization been in business as a Contractor?

2. How many years has your organization been in business under its present business name?

3. If a Corporation, answer the following:
Date of Incorporation: _____
State of Incorporation:_____
President: _____
Vice President(s): _____
_____
Secretary: _____
Treasurer: _____

4. If a Partnership, answer the following:
Date of organization: _____
Type of Partnership: _____
(General/Limited/Assoc.)
Name and Address of all partners.
_____
_____
_____

5. If other than a Corporation or Partnership, describe Organization and name Principals:
_____

What percent of the work do you normally perform with your own forces?

List trades:

_____	_____	_____
_____	_____	_____

Have you ever failed to complete any work awarded to you? If so, indicate when, where and why:

_____

_____

_____

8. Has any Officer or Partner of your Organization ever been an Officer or Partner of another Organization that failed to complete a construction contract? _____If so, state circumstances:

_____

_____

9. List major construction projects your Organization has under contract on this date:

Project Name	Name, Email Address & Telephone Number of Owner	Project Location	Contract Amount	Contract Date	Percent Complete	Scheduled Completion

10. List similar construction projects your Organization has completed in the past five years:

Project Name	Name, Email Address & Telephone Number of Owner	Project Location	Contract Amount	Date Awarded	Date Completed	Percent with Own Forces

11. List the construction experience of the principal individuals in your Organization:

Individual's Name	Construction Experience - Years	Within Your Organization		
		Present Position & Years Experience	Dollar Volume Responsibility	Previous Position & Years Experience

12. List states and categories in which your Organization is legally qualified to do business:

_____
_____
_____

13. List all Arizona Contractor licenses currently held by your Organization; the status of each license; and provide a photocopy of each license with your bid proposal.

	License Class / #	Status
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____

Please attach a list of additional Arizona Contractor licenses, if any.

14. Bank References:

_____
_____
_____

15. Trade References:

_____
_____
_____

16. Name of Bonding and Insurance Companies and Name and Address of Agents: Maximum Bonding Capacity _____

17. The Undersigned agrees to furnish, upon request by the Owner, within seven days after

the Bid Opening, a current Statement of Financial Conditions, including Contractor's latest regular dated financial statement or balance sheet which must contain the following items:

Current Assets: (Cash, joint venture accounts, accounts receivable, notes receivable, accrued interest on notes, deposits, and materials and prepaid expenses), net fixed assets and other assets.

Current Liabilities: (Accounts payable, notes payable, accrued interest on notes, provision for income taxes, advances received from owners, accrued salaries, accrued payroll taxes), other liabilities, and capital (capital stock, authorized and outstanding shares par values, earned surplus).

Date of statement or balance sheet: _____

Name of firm preparing statement: _____

By: _____
(Agent and Capacity)

18. List of Subcontractors. In accordance with paragraph 1.0 of Instructions to Bidders, the following is a breakdown of all subcontractors anticipated to be used for completing this project and their approximate percentage of work to be performed.

The Bidder certifies that all Subcontractors listed are eligible to perform Work on public works projects pursuant to ARS 34-241.

Subcontractor	Description of Work	% of Total Project
	Total % of all Subcontractor's work on project	
	Total % for Prime Contractor	

19. Dated at _____ this _ day of _____, _____

Name of Organization: _____

By: _____

Title: _____

** END OF SECTION **

SECTION 00430

AFFIDAVIT OF CONTRACTOR CERTIFYING THAT THERE WAS NO COLLUSION IN BIDDING FOR CONTRACT

STATE OF)
) ss
CITY OF)

(NAME OF INDIVIDUAL)

BEING DULY SWORN, DEPOSES AND SAYS:

THAT HE IS_____
(TITLE)

OF _____
(NAME OF BUSINESS)

THAT PURSUANT TO SECTION 34-253 OF THE ARIZONA REVISED STATUTES, HE CERTIFIES AS FOLLOWS:

THAT NEITHER HE NOR ANYONE ASSOCIATED WITH SAID

_____
(NAME OF BUSINESS)

HAS DIRECTLY, OR INDIRECTLY, ENTERED INTO ANY CONTRACT, PARTICIPATED IN ANY COLLUSION OR OTHERWISE TAKEN ANY ACTION IN RESTRAINT OF FREE COMPETITIVE BIDDING IN CONNECTION WITH THIS PROJECT.

_____
NAME

_____
TITLE

_____
NAME OF BUSINESS

SUBSCRIBED AND SWORN TO BEFORE ME THIS __ DAY OF _____, _____

MY COMMISSION EXPIRES: _____

NOTARY PUBLIC: _____

** END OF SECTION **

SECTION 00450
HAZARD COMMUNICATION PROGRAM
Lake Havasu City
SECTION 00440
COMPLIANCE WITH FAIR SHARE POLICY

This project is funded in whole or in part with funds provided by Water Infrastructure Finance Authority of Arizona (WIFA). WIFA provides financial assistance from the state and federally funded Clean Water Revolving Fund (CWRF) and the Drinking Water Revolving Fund (DWRF). As a recipient of benefits from state or federal funds through WIFA, the CITY must comply with the requirements of the Fair Share Policy.

The Fair Share Policy helps ensure that recipients of WIFA financial assistance award a fair share of contracting opportunities to minority business enterprises (MBEs), woman business enterprises (WBEs), and small businesses in rural areas (SBRAs). This Fair Share Policy is a requirement of the State of Arizona and the federal government. The Fair Share Policy applies to all prime contracts and sub-contracts for construction, equipment, supplies, and services.

The CONTRACTOR must document their meaningful actions to comply with the "Good Faith Effort" requirements. The CONTRACTOR will not be penalized if actual participation is below the set goals nor will they be relieved of continuing to make "Good Faith Efforts" if the goal is reached.

In order to comply with the Good Faith Effort, the CONTRACTOR must:

- Place qualified MBE/WBE/SBRA enterprises on solicitation lists.
- Assure that MBE/WBE/SBRA enterprises are solicited whenever they are potential sources.
- Divide project tasks, when economically feasible, into small tasks or quantities to permit maximum participation by MBE/WBE/SBRA enterprises.
- Establish delivery schedules when the requirements of the work permit, which will encourage participation by MBE/WBE/SBRA enterprises.
- Use the services and assistance of the Small Business Administration, the Minority Business Development Agency, and the Department of Commerce as resources to locate and contact MBE/WBE/SBRA enterprises.

A business qualifies as a MBE or WBE if it is:

- Certified as MBE or WBE by the Small Business Administration or other federal agency or certified by a State or State agency or
- An independent business concern that, although not certified, is at least 51 percent owned by one or more minority group members or women and whose daily business operations are managed and directed by one or more of the minority or women owners or
- In the case of a publicly owned business, at least 51 percent of the stock is owned by one or more minority group members or women and whose daily business operations are managed and directed by one or more of the minority or women owners.

A business qualifies as a SBRA if it is:

- A business concern that is physically located outside any standard metropolitan statistical area (SMSA) within Arizona.

SECTION 00450
HAZARD COMMUNICATION PROGRAM
Lake Havasu City

CERTIFICATION OF POSITIVE EFFORT - MBE/WBE/SBRA ENTERPRISE PARTICIPATION

Name of Prime Contractor:-

_____

:

_____ has made a Good Faith Effort to facilitate MBE/WBE/SBRA
(Contractor)

participation in this construction contract by satisfactorily following the affirmative action steps:

- Place qualified MBE/WBE/SBRA enterprises on solicitation lists.
- Assure that MBE/WBE/SBRA enterprises are solicited whenever they are potential sources.
- Divide project tasks, when economically feasible, into small tasks or quantities to permit maximum participation by MBE/WBE/SBRA enterprises.
- Establish delivery schedules when the requirements of the work permit, which will encourage participation by MBE/WBE/SBRA enterprises.
- Use the services and assistance of the Small Business Administration, the Minority Business Development Agency, and the Department of Commerce as resources to locate and contact MBE/WBE/SBRA enterprises.

CONTRACTOR shall maintain documentation related to MBE/WBE/SBRA Good Faith Effort, sub-contractor selection, and MBE/WBE/SBRA participation, in the project files and make available upon request by the CITY.

I, the undersigned representative of _____ hereby
(Contractor)

certify that all of the information provided herein is correct to the best of my knowledge and belief.

_____ _____
(Signature of Authorized Representative) *(Date)*

_____
(Type or Print Name of Authorized Representative)

Please list any MBE/WBE/SBRA enterprises selected to provide services, equipment, or supplies for this project on the following sheet (if any).

SECTION 00450
HAZARD COMMUNICATION PROGRAM
Lake Havasu City

The following MBE/WBE/SBRA enterprises have been selected to provide services, equipment, or supplies for the listed project:

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

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(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

_____ MBE WBE SBRA
(Name of Company) *(Circle if applicable)*

HAZARD COMMUNICATION PROGRAM FOR_____
(*Name of Company*)
The purpose of this program is to ensure that potential hazards and hazard control measures for chemicals used by this company are understood by company employees.

The written program is available for employee review at any time. It is located _____. A copy of the program will be provided to any employee or employee representative, upon request.

CONTAINER LABELING:
_____ will verify that all containers received for use by this company will: (name/title of individual)

* be clearly labeled as to the contents, matching identification on MSDS;
* note the appropriate hazard warnings;
* List the name and address of the manufacturer.

No containers will be released for use until the above data is verified.

MATERIAL SAFETY DATA SHEETS:
Copies of MSDS's for all hazardous chemicals to which employees may be exposed will be kept
_____.
_____ will be responsible for ensuring that:
(name/title of individual)

* MSDS's for the new chemicals are available;
* MSDS's will be available for review to all employees during each work shift;
* Copies will be available on request.

EMPLOYEE TRAINING AND INFORMATION:
Each employee will be provided the following information and training before working in areas where hazardous chemicals exist. In addition, if a new hazardous material is introduced into the workplace, affected employees will be given new information and training concerning that material.

A. Minimum Information Provided:

(1) All operations and locations in the work area where hazardous chemicals are present.

GENERAL INDUSTRY

A. Minimum Information Provided:

(1) The location and availability of the written hazard communication program, including list(s) of hazardous chemicals used and related material safety data sheets;
(2) The method the company will use to inform employees of potential hazards of non-routine tasks (jobs that are not routine for an individual because of infrequency, location or type.)

B. Minimum Training Provided:

(1) Methods and observations used to detect the presence or release of a hazardous chemical in the work area (such as company monitoring programs, continuous monitoring device, visual appearance, odor or to other characteristics of hazardous chemicals;

(2) The physical and health hazards of chemicals in the assigned work area;

(3) The measures to take to protect against such hazards, including specific company procedures concerning work practices, emergencies and care and use of protective equipment.

(4) Details of the company hazard communication program, including explanation of the labeling system, the material safety data sheets, and how to obtain and use the appropriate hazard information.

(OPTIONAL) Upon completion of the training, each employee will sign a form acknowledging receipt of the written hazard communication program and related training.

HAZARDOUS NON-ROUTINE TASKS: (If applicable.)
If company employees are required to do hazardous non-routine tasks, such as welding in confined spaces, or cleaning of tanks, the employer must address how the employees doing the work will be informed about the specific hazards to which they will be exposed, what personal protective equipment will be provided and who will be responsible to oversee the operation or operations. If the company does not have any hazardous non-routine tasks, line through this section and state "NO HAZARDOUS NON-ROUTINE TASKS".

CHEMICALS IN UNLABELED PIPES: (If applicable.)
If the company has chemicals in unlabeled pipes, the company must inform the employees of the hazards associated with those chemicals. If the company does not have any chemicals in unlabeled pipes, line through this section and state "NO CHEMICALS IN UNLABELED PIPES".

INFORMING CONTRACTORS:
Providing contractors and their employees with the following information is the responsibility of _____.

(Name/title of individual)

(1) Hazardous chemicals to which they may be exposed while on the job site;
(2) Measures the employees may take to lessen the possibility of exposure;
(3) Steps the company has taken to lessen the risks;
(4) Where the MSDS's are for chemicals to which they may be exposed;
(5) Procedures to follow if they are exposed.

CONTRACTORS INFORMING EMPLOYERS:
Contractors entering this workplace with hazardous materials will supply this employer with MSDS's covering those particular products the contractor may expose this company's employees to while working at this site.

LIST OF HAZARDOUS CHEMICALS IN THIS WORKPLACE
_____
_____
_____
_____

CONTRACTOR:
By: _____

Name: _____

Title: _____

Address: _____

END OF SECTION

LAKE HAVASU CITY
EMPLOYMENT ELIGIBILITY VERIFICATION & FORM

INSTRUCTIONS FOR COMPLETION OF EMPLOYMENT ELIGIBILITY VERIFICATION FORM

WHO MUST COMPLETE THIS FORM:
In accordance with Lake Havasu City Code Chapter 3.30, Employment of Unauthorized Aliens, all contractors and subcontractors furnishing labor, time, or effort for construction or maintenance of any structure, building, transportation facility, or improvements of real property must complete this form.

Contractors or subcontractors, as described above, must certify that they have complied, in good faith, with the applicable requirements of the Federal Immigration Control and Reform Act with respect to the hiring of covered employees. This certification must be executed by an authorized representative.

WHEN THIS FORM MUST BE COMPLETED:
This form must be completed by all contractors and subcontractors and submitted to the City department awarding the contract, license agreement, or lease no later than notification of successful direct selection, bid, request for proposals, request for qualification, or any similar competitive or noncompetitive procurement or bidding process.

LAKE HAVASU CITY
EMPLOYMENT ELIGIBILITY VERIFICATION & FORM

LIST OF ACCEPTABLE DOCUMENTS:

LIST A		LIST B		LIST C
Documents that Establish Both		**Documents that Establish**		**Documents that Establish**
U.S. Passport (unexpired or expired)	**OR**	Driver's license or ID Card issued by a state or outlying possession of the United States provided it contains a photograph or information such as name date of birth	**AND**	U.S. social security card issued by the Social Security Administration
Certificate of U.S. Citizenship		ID card issued by a federal, state or local government agencies or entities, provided it contains a photograph or information		Certification of Birth Abroad issued by the Department of State
Certificate of Naturalization		School ID card with photograph		Original or certified copy of a birth certificate issued by a state, county, municipal authority or outlying
Unexpired foreign passport with I-551 stamp or attached federal Form I-94		Voter's registration card		Native American tribal document
Permanent Resident Card or Alien		U.S. Military card or draft record		U.S. Citizen ID Card
Unexpired Temporary		Military dependent's ID card		ID Card for the use of Resident Citizen in the
Unexpired Employment		U.S. Coast Guard Merchant Mariner Card		Unexpired employment authorization document issued by DHS
Unexpired Reentry		Native American tribal		
Unexpired Refugee Travel Document		Driver's license issued by a		
Unexpired Employment Authorization Document issued by DHS that contains a		**For persons under age 18 who are unable to present a document listed above:** School record or report card; Clinic,		

EMPLOYER VERIFICATION OF EMPLOYMENT ELIGIBILITY & FORM

The undersigned attests under penalty of perjury, that they have reviewed the documents presented to them by their employees, and that the documents provided to the undersigned by their employees, as more particularly identified in the attached exhibit entitled "list of acceptable documents" appear to be genuine and appear to relate to the employee name, and to the best of the undersigned's knowledge, the employee is eligible to work in the United States based upon the undersigned's review of the documents presented.

Signature of Authorized Representative of Covered Employer/Contractor/ Subcontractor	**Print Name**	**Title**
Business or Organization Name	**Business Phone Number**	**Date (month/date/year)**
Address (Street Name and Number)		
City, State, Zip Code		

SECTION 00500
CONTRACT

THIS CONTRACT is entered into by and between LAKE HAVASU CITY, ARIZONA, a municipal corporation ("OWNER"), and _____a(n) ARIZONA corporation,
Federal I.D. # ("CONTRACTOR").

WHEREAS, OWNER has developed plans for and desires to commence the Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707 ("PROJECT"); and

WHEREAS, CONTRACTOR represents that it possesses the experience, competence, equipment and financing to properly complete the PROJECT, and has formally proposed to do so, and to furnish all necessary labor, materials, and equipment and services therefore in accordance with said plans, and subject to the terms and conditions hereof.

NOW, THEREFORE, in consideration of these promises and the mutual covenants herein, it is hereby agreed as follows:

1. CONTRACTOR shall commence and complete the construction of the PROJECT;

2. CONTRACTOR shall furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the PROJECT.

3. CONTRACTOR shall commence the PROJECT in accordance with the CONTRACT DOCUMENTS within TEN (10) calendar days after the date of the Notice to Proceed. Final completion of the PROJECT shall occur within **[XXX] calendar days** of the date of the Notice to Proceed. The period for completion may be extended through the authorized and approved change order process.

4. Liquidated Damages: OWNER and CONTRACTOR recognize that time is of the essence of this CONTRACT and that OWNER will suffer financial loss if the PROJECT is not completed within the time specified in paragraph 3 above, plus any extensions thereof allowed in accordance with the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual losses or damages (including special, indirect, consequential, incidental and any other losses or damages) suffered by OWNER if a complete acceptable PROJECT is not delivered on time.

   Accordingly, and instead of requiring proof of such losses or damages, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay the OWNER **$XXX** for each calendar day that expires after the time specified in paragraph 3 for delivery of acceptable Bid Items, plus any costs incurred by the Engineer as provided in Section 17 of the General Conditions.

5. CONTRACTOR agrees to complete the PROJECT in accordance with all of the terms and conditions of the CONTRACT DOCUMENTS for the sum of **$XXXXX** as shown

in the Bid Schedule.

6. CONTRACTOR shall submit a completed Section 00450 entitled Hazard Communication Program with the executed copy of this CONTRACT.

7. The term "CONTRACT DOCUMENTS" means and includes the following:
00020 Notice Inviting Bids
00100 Information for Bidders
00300 Bid Proposal
00310 Bid Price Schedule
00400 Bid Bond
00420 Bidder's Statement of Qualifications
00430 Bidder's Affidavit of No Collusion
00450 Hazard Communication Program
00460 Employment Eligibility Verification
00500 CONTRACT
00500A Indemnification and Insurance Requirements
00500B Contractor Claim Handling Procedure
00510 Arizona Statutory Performance Bond
00520 Arizona Statutory Payment Bond
00670 Notice of Award
00680 Notice to Proceed
00685 Certificate of Substantial Completion
00690 Certificate of Final Completion
00700 General Conditions
00800 Special Provisions
Technical Specifications and Details
Construction Contract Drawings
Change Orders
Lien Releases (Conditional and Final)
Addenda

8. OWNER shall pay CONTRACTOR in the manner and at such times as set forth in the General Conditions and in such amounts as required by the CONTRACT DOCUMENTS.

9. In the event CONTRACTOR fails to perform any portion of the PROJECT or satisfy any term or condition of the CONTRACT DOCUMENTS, OWNER may at its sole discretion file notice and/or claim of such failure with CONTRACTOR'S surety.

10. Israel. If applicable, Contractor certifies that it is not currently engaged in, and agrees for the duration of this Contract that it will not engage in, a boycott of goods and services from Israel, as defined in A.R.S. § 35-393.

11. Conflict of Interest. The Contract may be cancelled in accordance with Arizona Revised Statutes Section 38-511.

12. Forced Labor of Ethnic Uyghurs Certification. If applicable, Contractor certifies that it does not currently, and agrees for the duration of the Contract that it will not, use: (1) the forced labor of ethnic Uyghurs in the People's Republic of China; (2) any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China; or (3) any contractors, subcontractors, or suppliers that use the forced labor or any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China. If Contractor becomes aware it is not in compliance with this certification, it shall notify the City within five business days after becoming aware. This Contract will terminate upon failure to remedy the noncompliance within 180 days of the notification. (A.R.S. § 35-394)

13. Export Administration Act. The CONTRACTOR warrants compliance with the Export Administration Act.

14. Recyclable Products. The CONTRACTOR shall use recyclable products and products which contain recycled content to the maximum extent economically feasible in the performance of the work set forth in the CONTRACT.

15. Asbestos License. The CONTRACTOR shall possess an asbestos abatement license if required under A.R.S. Title 32 or 49.

16. Assignment. No right or interest in this CONTRACT shall be assigned by CONTRACTOR without prior, written permission of the OWNER signed by the City Manager; and no delegation of any duty of CONTRACTOR shall be made without prior written permission of the OWNER signed by the City Manager. Any attempted assignment or delegation by CONTRACTOR in violation of this provision shall be a breach of this CONTRACT by CONTRACTOR.

[SIGNATURES ON FOLLOWING PAGE]

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this CONTRACT in two (2) copies, each of which shall be deemed an original. The last date of signature shall be the effective date of this CONTRACT.

OWNER:
Lake Havasu City, Arizona

By: _____ Date: _____

Name: _____
Title: _____

APPROVED AS TO FORM:
Lake Havasu City Attorney's Office

By: _____ Date: _____

CONTRACTOR:

By: _____ Date: _____

Name/Title: _____

Address: _____

ATTEST:

BY: _____

Name/Title: _____

** END OF SECTION **

LAKE HAVASU CITY CONSTRUCTION CONTRACT
INDEMNIFICATION AND INSURANCE REQUIREMENTS
(long form)

I. INDEMNIFICATION

CONTRACTOR agrees to indemnify, defend, save, and hold harmless the CITY, its departments, agencies, boards, commissions, officers, officials, agents, volunteers, and employees ("CITY") from and against any and all claims, actions, liabilities, damages, losses, or expenses (including court costs, attorney's fees, and costs of claim processing, investigation, and litigation) ("Claims") for bodily injury or personal injury (including death), or loss or damage to tangible or intangible property caused, or alleged to be caused, in whole or in part, by the CONTRACTOR or any of its owners, officers, directors, agents, employees, or contractors. This Indemnity includes any claim or amount arising out of or recovered under Workers' Compensation law or arising out of the failure of the CONTRACTOR to conform to any federal, state, or local law, statute, ordinance, rule, regulation, or court decree. It is the specific intention of the parties that the CITY shall, in all instances, except for Claims arising solely from the negligent or willful acts or omissions of the CITY, be indemnified by CONTRACTOR from and against any and all claims. It is agreed that CONTRACTOR will be responsible for primary loss investigation, defense, and judgment costs where this indemnification is applicable. The amount and type of insurance coverage requirements required by this Agreement will in no way be construed as limiting the scope of indemnity in this Section.

II. INSURANCE REQUIREMENTS

A. CONTRACTOR and its subcontractors shall procure and maintain until all of their obligations have been discharged, including any warranty periods under this CONTRACT, are satisfied, insurance against claims for injury to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the CONTRACTOR, its agents, representatives, employees or subcontractors.

B. The insurance requirements herein are minimum requirements for this CONTRACT and in no way limit the indemnity covenants contained in this CONTRACT. City in no way warrants that the minimum limits contained herein are sufficient to protect the CONTRACTOR from liabilities that might arise out of the performance of the work under this CONTRACT by the CONTRACTOR, its agents, representatives, employees or subcontractors, and CONTRACTOR is free to purchase additional insurance.

C. MINIMUM SCOPE AND LIMITS OF INSURANCE: CONTRACTOR shall provide coverage with limits of liability not less than those stated below.

1. **Commercial General Liability – Occurrence Form**
   Policy shall include bodily injury, property damage, personal injury and broad form contractual liability coverage.
   a. General Aggregate $2,000,000
   b. Products – Completed Operations Aggregate $1,000,000
   c. Personal and Advertising Injury $1,000,000
   d. Blanket Contractual Liability – Written and Oral $1,000,000

e. Fire Legal Liability $ 50,000
f. Each Occurrence $1,000,000

i. The policy shall be endorsed to include the following additional insured language: ***"Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees shall be named as additional insureds with respect to liability arising out of the activities performed by or on behalf of the CONTRACTOR".***

ii. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

iii. Completed operations coverage shall remain effective for at least two years following expiration of CONTRACT.

2. **Business Automobile Liability**

a. Bodily Injury and Property Damage for any owned, hired, and/or non-owned vehicles used in the performance of this CONTRACT.

Combined Single Limit (CSL) $1,000,000

i. The policy shall be endorsed to include the following additional insured language: "Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees shall be named as additional insureds with respect to liability arising out of the activities performed by or on behalf of the CONTRACTOR, involving automobiles owned, leased, hired or borrowed by the CONTRACTOR."

ii. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

3. **Workers' Compensation and Employers' Liability**

a. Workers' Compensation Statutory

b. Employers' Liability Each Accident $ 500,000
Disease – Each Employee $ 500,000
Disease – Policy Limit $1,000,000

i. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

ii. This requirement shall not apply if exempt under A.R.S. Section 23-901.

4. **Professional Liability (Errors and Omissions Liability)***
***If Applicable**

a. Each Claim $1,000,000
b. Annual Aggregate
$2,000,000

i. In the event that the professional liability insurance required by this CONTRACT is written on a claims-made basis, CONTRACTOR warrants that any retroactive date under the policy shall precede the effective date of this CONTRACT; and that either continuous coverage will be maintained or an extended discovery period will be exercised for a period of two (2) years beginning at the time work under this CONTRACT is completed.

ii. The policy shall cover professional misconduct or lack of ordinary skill for those positions defined in the Scope of Work of this CONTRACT.

5. **Indemnity–Patents, Copyright, and Trademark.**

Contractor agrees to defend City, mayor, council, appointed boards and commissions, officers, officials, employees, and agents its departments, agencies, boards, commissions, officers, officials, agents, volunteers, and employees individually and collectively at Contractor's own expense, in all suits, actions, or proceedings in which Contractor is made a defendant for actual or alleged infringement of any United States of America or foreign letters patents resulting from Contractor's use of the goods, service, or finished end product purchased as a result of this Procurement (Invitation To Bid (ITB) or Request For Proposal (RFP)) and subsequent Contract. Contractor further agrees to pay and discharge any and all judgments or decrees which may be rendered in any such suit, action, or proceedings against City. Contractor agrees to indemnify and hold harmless the City from any and all license, royalty and proprietary fees or costs, including legal costs, which may arise out of City's purchase and use of goods, service, or finished end product supplied by the Contractor. Contractor will indemnify City against all claims for damages to persons or property resulting from defects in materials or workmanship. It is expressly agreed by Contractor that these covenants are irrevocable and perpetual.

6. **Contractor's Personal Property**

CONTRACTOR and each of its subcontractors and suppliers shall be solely responsible for any loss or damage to its or their personal property and that of their employees and workers, including, without limitation, property or materials created or provided pursuant to this CONTRACT, any subcontract or otherwise, its or their tools, equipment, clothing, fencing, forms, mobile construction equipment, scaffolding, automobiles, trucks, trailers or semi-trailers including any machinery or apparatus attached thereto, temporary structures and uninstalled materials, whether owned, used, leased, hired or rented by CONTRACTOR or any subcontractor, consultant or supplier or employee or worker (collectively, "Personal Property"). CONTRACTOR and its subcontractors, consultants and suppliers, at its or their option and own expense, may purchase and maintain insurance for such Personal Property and any deductible or self-insured

retention in relation thereto shall be its or their sole responsibility. Any such insurance shall be CONTRACTOR's and the subcontractors', suppliers' volunteers and employees' and workers' sole source of recovery in the event of loss or damage to its or their Personal Property. Any such insurance purchased and maintained by CONTRACTOR and any subcontractor, consultant or supplier shall include a waiver of subrogation as to Owner. CONTRACTOR waives all rights of recovery, whether under subrogation or otherwise, against all such parties for loss or damage covered by CONTRACTOR's property insurance. CONTRACTOR shall require the same waivers from all subcontractors and suppliers and from the insurers issuing property insurance policies relating to the Work or the Project purchased and maintained by all subcontractors and suppliers. The waivers of subrogation referred to in this subparagraph shall be effective as to any individual or entity even if such individual or entity (a) would otherwise have a duty of indemnification, contractual or otherwise, (b) did not pay the insurance premium, directly or indirectly, and (c) whether or not such individual or entity has an insurable interest in the property which is the subject of the loss or damage.

7. **Theft, Damage, or Destruction of Work**

In the event of theft, damage or destruction of the Work, CONTRACTOR will re-supply or rebuild its Work without additional compensation and will look to its own resources or insurance coverages to pay for such re-supply or rebuilding. CONTRACTOR will promptly perform, re-supply or rebuild, regardless of the pendency of any claim by CONTRACTOR against any other party, including Owner, that such party is liable for damages, theft or destruction of CONTRACTOR's Work. This subparagraph shall apply except to the extent that the cost of re-supply or rebuilding is paid by Owner's builder's risk insurance; in such event, Owner waives (to the fullest extent permitted by the builder's risk policy) all rights of subrogation against CONTRACTOR and each of its subcontractors to the extent of such payment by Owner's builder's risk insurer.

D. ADDITIONAL INSURANCE REQUIREMENTS: The policies shall include, or be endorsed to include, the following provisions:

1. Lake Havasu City, its departments, agencies, boards, commissions and its officers, officials, agents, volunteers and employees wherever additional insured status is required. Such additional insured shall be covered to the full limits of liability purchased by the CONTRACTOR, even if those limits of liability are in excess of those required by this CONTRACT.
2. The Contractor's insurance coverage shall be primary insurance with respect to all other available sources.
3. Coverage provided by the Contractor shall not be limited to the liability assumed under the indemnification provisions of this CONTRACT.

E. NOTICE OF CANCELLATION: Each insurance policy required by the insurance provisions of this CONTRACT shall not be suspended, voided, cancelled, reduced in coverage or in limits without ten (10) business days written notice to City. Such notice shall be mailed directly to Lake Havasu City, Administrative Services Department, Procurement Division, 2330

McCulloch Blvd. North, Lake Havasu City, AZ, 86403 and shall be sent by certified mail, return receipt requested.

F. ACCEPTABILITY OF INSURERS**:** Insurance is to be placed with duly licensed or approved non-admitted insurers in the state of Arizona with an "A.M. Best" rating of not less than A-VII. CITY in no way warrants that the above-required minimum insurer rating is sufficient to protect the CONTRACTOR from potential insurer insolvency.

G. VERIFICATION OF COVERAGE**:**

1. CONTRACTOR shall furnish CITY with certificates of insurance as required by this CONTRACT. The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf and the Project/contract number and project description shall be noted on the certificate of insurance.
2. All certificates and endorsements are to be received and approved by CITY at least ten (10) days before work commences. Each insurance policy required by this CONTRACT must be in effect at or prior to commencement of work under this CONTRACT and remain in effect for the duration of the Project. Failure to maintain the insurance policies as required by this CONTRACT, or to provide evidence of renewal, is a material breach of contract.
3. All renewal certificates required by this CONTRACT shall be sent directly to Lake Havasu City, Administrative Services Department, Procurement Division, 2330 McCulloch Blvd. North, Lake Havasu City, AZ, 86403. The Project/contract number and project description shall be noted on the certificate of insurance. CITY reserves the right to require complete, certified copies of all insurance policies required by this CONTRACT at any time**.**

H. SUBCONTRACTORS**:** CONTRACTOR's certificate(s) shall include all subcontractors as insureds under its policies **or** CONTRACTOR shall furnish to CITY separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to the minimum requirements identified above.

I. APPROVAL**:** Any modification or variation from the insurance requirements in this CONTRACT must have prior approval from the CITY's Human Resources/Risk Management Division, whose decision shall be final. Such action will not require a formal CONTRACT amendment, but may be made by administrative action.

J. EXCEPTIONS**:** In the event the CONTRACTOR or sub-contractor(s) is/are a public entity, then the Insurance Requirements shall not apply. Such public entity shall provide a Certificate of Self-Insurance.

SECTION 00500B
CONTRACTOR Claim Handling Procedure

1. Claimant is to submit in writing to the OWNER or their REPRESENTATIVE the details of the claim to include the where, when, and how of the claim, and an estimate of damage, if applicable.

2. OWNER or their REPRESENTATIVE will forward the claim directly to the CONTRACTOR for handling. The CONTRACTOR is to respond to the claimant, in writing, within 30 calendar days of receipt with copies to:

   Lake Havasu City Human Resources/Risk Management Division
   Lake Havasu City Administrative Services Department
   OWNER'S REPRESENTATIVE, if applicable

   If the CONTRACTOR denies the claim, the reasons for such denial must be included in the response to the claimant.

SECTION 00510
ARIZONA STATUTORY PERFORMANCE BOND

PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT: _____ (hereinafter "Principal"), as Principal, and _____ (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona (hereinafter "Obligee") in the amount of **WRITTEN AMOUNT AND 00/100** (Dollars) (**$#,###,###.##-NUMERIC AMOUNT**), for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the ____ day of _____, _____, to furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of

Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707

which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THE OBLIGATION IS SUCH, that if the Principal faithfully performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of the contract during the original term of the contract and any extension of the contract, with or without notice of the Surety, and during the life of any guarantee required under the contract, and also performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of all duly authorized modifications of the contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, the above obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this ____ day of _____ , _____.

_____

PRINCIPAL SEAL

_____ BY:_____

AGENCY OF RECORD

_____ _____

AGENCY ADDRESS SURETY SEAL

BY:_____

** END OF SECTION **

SECTION 00520
ARIZONA STATUTORY PAYMENT BOND
PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT: _____

(hereinafter "Principal"), as Principal, and _____

_____

(hereinafter Surety), a corporation organized and existing under the laws of the State of with its principal office in the City of _____

_____,

holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona (hereinafter "Obligee") in the amount of **WRITTEN AMOUNT AND 00/100 (Dollars) (($#,###,###.##-NUMERIC AMOUNT)** for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ of _____, _____, to furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of

Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707

which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFOR, THE CONDITION OF THE OBLIGATION IS SUCH, that if the Principal promptly pays all monies due to all persons supplying labor or materials to the Principal or the Principal's subcontractors in the prosecution of the work provided for in the contract, this obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statues, and all liabilities on this bond shall be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this ___ day of _____, _____.

_____
PRINCIPAL SEAL

_____ BY:_____
AGENCY OF RECORD

_____ _____
AGENCY ADDRESS SURETY SEAL

BY:_____

** END OF SECTION **

SECTION 00670

NOTICE OF AWARD

TO: **DATE:**

PROJECT DESCRIPTION: Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707

The OWNER has considered the BID submitted by you for the above described WORK in response to its Advertisement for BIDS dated [DATE BID FIRST ADVERTISED], and Information for Bidders.

You are hereby notified that your BID has been accepted for items in the amount of $, to include: [LIST BID ITEMS AWARDED]

You are required by the Information for Bidders to execute the Contract and furnish the required CONTRACTOR'S Performance Bond, Payment Bond, and Certificates of Liability, Vehicular, and Workmen's Compensation Insurance within ten (10) calendar days from the postmark date when this notice was sent by U.S. Mail.

If you fail to execute said Contract and to furnish said BONDS within ten (10) days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID BOND. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this [DATE] day of [MONTH], 20##.

Lake Havasu City, Arizona

BY: _____

NAME: Lynette Singleton

TITLE: Procurement Official

Acceptance of Notice

(NOTE: The contractor shall return a signed copy of this notice to the owner.)

Receipt of this NOTICE OF AWARD is hereby acknowledged by:

Contractor

This the ____ day of _____, 20##.

BY: _____ TITLE: _____

** END OF SECTION **

REV 3/30/16

SECTION 00685
CERTIFICATE OF SUBSTANTIAL COMPLETION

I hereby state that the degree of completion of:

Water Treatment Plant Improvements Project,
Project No. B26-PW-108025-500707

Provides the full-time use of the project, or defined portion of the project, for the purposes for which it was intended and is the commencement of the Guarantee Period.

"Substantial Completion" shall not be considered as final acceptance.

Lake Havasu City, Arizona

Date: _____

By: _____

Name: _____

Title: _____

ACCEPTANCE OF NOTICE

(NOTE: The Contractor shall return a signed copy of this Notice to the Owner)

Receipt of the above **CERTIFICATE OF SUBSTANTIAL COMPLETION** is hereby acknowledged this the _____ day of _____, _____.

By: _____

Name: _____

Title: _____

E-original: [CONTRACTOR]
E-copy: Procurement (Purchasing@lhcaz.gov)
Lake Havasu City, City Clerk (CityClerk@lhcaz.gov)

CERTIFICATE OF COMPLETION

I hereby state that all goods and services required by:

Water Treatment Plant Improvements Project,
Project No. B26-PW-108025-500707

have been delivered in conformance with the Contract, and all activities required by the Contractor under the Contract were completed as of _____.
(Date)

Lake Havasu City, Arizona

By: _____

Name:_____

Title: _____

E-original: [CONTRACTOR]
E-copy: Procurement (Purchasing@lhcaz.gov)
City Clerk (CityClerk@lhcaz.gov)

SECTION 00700
GENERAL CONDITIONS

This section of the Contract Documents is pre-printed. Any modifications to the following Articles, as may be required for this Project, are made in the Special Provisions.

1.0 DEFINITIONS

Wherever in the Contract Document the following terms are used, the intent and meaning shall be interpreted as follows:

1.1 Addenda

Written or graphic instruments issued prior to the opening of Bids which modify or interpret the Contract Documents, Drawings and Specifications, by additions, deletions, clarifications or corrections.

1.2 As Approved

The words "as approved," unless otherwise qualified, shall be understood to be followed by the words "by the Owner."

1.3 As Shown, and as Indicated

The words "as shown" and "as indicated" shall be understood to be followed by the words "on the Drawings" or "in the Specifications."

1.4 Award

The acceptance, by the Owner, of the successful Bidder's proposal.

1.5 Bid

The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

1.6 Bidder

Any individual, firm partnership or corporation, or combination thereof submitting a proposal for the Work contemplated, acting directly or through a duly authorized representative.

1.7 Bonds

Bid, Performance, and Payment Bonds and other instruments of security, furnished by the Contractor and its surety in accordance with the Contract Documents.

1.8 Calendar Day

Every day shown on the calendar, measured from midnight to the next midnight.

1.9 Change Order

A written order to the Contractor, signed by the Owner, covering changes in the Plans, Specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for the Work affected by such changes.

If the Change Order increases the existing Contract Amount, the Builder's Risk Insurance limit must be increased to the adjusted Contract Amount.

1.10 Contract

The "Contract" is the written Contract covering the performance of the Work and the furnishing of labor, materials, incidental services, tools, and equipment in the construction of the Work. It includes Supplemental Contracts amending or extending the Work contemplated in the manner hereinafter described and which may be required to complete the Work in a substantial and acceptable manner to the Owner. The Contract may include Contract Change Orders.

1.11 Contract Documents

The "Contract Documents" consist of the Bidding Requirements, Contract Forms, Conditions of the Contract including General and/or Supplemental General Conditions, Special Provisions, the Technical Specifications, and the Drawings, including all Addenda and modifications thereafter incorporated into the Documents before execution and including all other requirements incorporated by specific reference thereto.

1.12 Contract Price

The total monies payable by Owner to the Contractor under the terms and conditions of the Contract Documents.

1.13 Contract Time

The number of calendar days stated in the Contract Documents for the completion of the Work.

1.14 Contractor

The individual, partnership, firm, or corporation primarily liable for the acceptable performance of the Work contracted for and the payment of all legal debts pertaining to the Work who acts directly or through lawful agents or employees to complete the Contract Work.

1.15 Days

Unless otherwise specifically stated, the term "days" will be understood to mean calendar days.

1.16 Drawings

The term "Drawings," also described as "Plans," refers to the official drawings, profiles, cross sections, elevations, details, and other working drawings, and supplementary drawings, or reproductions thereof, which show the locations, character, dimensions, and details of the Work to be performed. Drawings may either be bound in the same book as the balance of the Contract Documents or bound in separate sets, and are a part of the Contract Documents, regardless of the method of binding.

1.17 Engineer

The individual, partnership, firm, or corporation duly authorized by the Owner (sponsor) to be responsible for the Engineering of the contract Work and acting directly or through an authorized representative.

1.18 Field Order

A written order effecting a change in the Work not involving an adjustment in the Contract Price or an extension of the Contract Time, issued by the Engineer to the Contractor during construction.

1.19 Final Acceptance

Upon due notice from the Contractor of presumptive completion of the entire project, the Owner will make an inspection. If all construction provided for and contemplated by the contract is found completed to the Owner's satisfaction and all requirements of the contract have been met, that inspection shall constitute the final inspection and the Owner will make the final acceptance and issue the Certificate of Completion.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory or that all requirements of the contract have not been met, the Owner will give the Contractor the necessary instructions for correction or completion, and the Contractor shall immediately comply with and execute the instructions. Upon correction of the work, completion of contract requirements, and notification to Owner, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed and all requirements of the contract met. In such event, the Owner will make the final acceptance and issue the Certificate of Completion.

1.20 Inspector

An authorized representative of the Owner assigned to make all necessary inspections and/or tests of the Work performed or being performed, or of the materials furnished or being furnished by the Contractor.

1.21 Methodology and Quality of Workmanship

The manner and sequence of construction which considered to be the acceptable standard in which to perform the Work.

1.22 Notice

The term "notice" or the requirement to notify, as used in the Contract Documents or applicable State or Federal statutes, shall signify a written communication delivered in person or by certified or registered mail to the individual, or to a member of the firm, or to an officer of the corporation for whom it is intended. Certified or registered mail shall be addressed to the last business address known to him who gives the notice.

1.23 Notice of Award

The written notice of the acceptance of the Bid from the Owner to the successful Bidder.

1.24 Notice to Proceed

Written communication issued by the Owner to the Contractor authorizing him to proceed with the Work and establishing the date of commencement of the Work.

1.25 Or Equal

The phrase "or equal" shall be understood to indicate that the "equal" product is the same or better than the product names in function, performance, reliability, quality, and general configuration. Determination of equality in reference to the project design requirements will be made by the Owner.

1.26 Owner

The term "Owner" shall be understood to be Lake Havasu City, Arizona.

1.27 Payment Bond

The approved form of security furnished by the Contractor and its surety as a guaranty that it will pay in full all bills and accounts for materials and labor used in the construction of Work.

1.28 Performance Bond

The approved form of security furnished by the Contractor and its surety as a guarantee that the Contractor will complete the Work in accordance with the terms of the Contract and guarantee the Work for a period of one (1) year after the date of Certificate of Substantial Completion.

1.29 Plans

Plans shall have the same meaning as "Drawings," see Section 1.16.

1.30 Project

The undertaking to be performed as provided in the Contract Documents, see Section 1.11.

1.31 Proposal

The offer of the Bidder for the Work when made out and submitted on the prescribed proposal form, properly signed and guaranteed.

1.32 Proposal Guarantee

The cash, or cashier's check or certified check, or bidder's bond accompanying the Proposal submitted by the Bidder, as a guarantee that the Bidder will enter into a contract with the Owner for the construction or doing of the Work, if it is awarded to it, and will provide the contract bonds and insurance required.

1.33 Shop Drawings

All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a Subcontractor, manufacturer, supplier or distributor, which illustrate how specific portions of the Work shall be fabricated or installed.

1.34 Specifications

The directions, provisions and requirements pertaining to the method and manner of performing the Work or to the quantities and qualities of the materials to be furnished under the Contract, together with all other directions, provisions and requirements, plus such amendments, deletions from or additions which may be provided for by Supplemental Contract or Change Orders.

1.35 Subcontractor

A Subcontractor is a person or entity who has a direct or indirect contract with a Contractor to perform any of the Work at the site. For convenience, the term Subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender but includes the plural and feminine gender and includes a Sub-Subcontractor or an authorized representative thereof. The term Subcontractor does not include any separate Contractor or its Subcontractors.

1.36 Substantial Completion

"Substantial Completion" shall be that degree of completion of the project or a defined portion of the project, sufficient to provide the Owner, at its discretion, the full-time use of the project or defined portion of the project for the purposes for which it was intended. "Substantial Completion" shall not be considered as final acceptance.

1.37 Supplemental General Conditions

Modifications to General Conditions required by a Federal Agency for participation in the Project and approved by the agency for participation in the Project and approved by the agency in writing prior to inclusion in the Contract Documents and such requirements that may be imposed by applicable state laws. The term also includes modifications or additions to the General Conditions required by the Owner or Engineer.

1.38 Supplier

Any person or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the site.

1.39 Surety

The corporation, partnership, or individual, other than the Contractor, executing Payment, or Performance Bonds which are furnished to the Owner by the Contractor.

1.40 Work

The word "Work" within these Contract Documents shall include all material, labor, tools, utilities, and all appliances, machinery, transportation, and appurtenances necessary to perform and complete the Contract, and such additional items not specifically indicated or described which can be reasonably inferred as belonging to the item described or indicated and as required by good practice to provide a complete and satisfactory system or structure.

1.41 Working Day

A working day shall be any day, other than a legal holiday, Saturday or Sunday, on which the normal working forces of the Contractor may proceed with regular work.

2.0 NOTICE TO PROCEED

2.1 After the Owner has issued the Notice Of Award, the Contractor shall provide the Performance Bond, the Payment Bond, the Certificate Of Insurance, the Work Schedule, the monthly cash flow, and a signed Contract within ten (10) calendar days. The Owner's attorney will review each document and, if they are found to be acceptable, the Owner will sign and

execute the Contract. Within a period of sixty (60) calendar days after executing the Contract, the Owner will issue the Notice To Proceed. Within ten (10) calendar days of the postmark date of the Notice To Proceed, the Work shall commence. The Contractor shall not commence any Work until such time that the Notice To Proceed has been issued.

3.0 ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

3.1 The Engineer may furnish additional instructions to the Contractor by means of Drawings or otherwise, during the progress of the Work as necessary to make clear or to define in greater detail the intent of the Specifications and Contract Drawings.

The additional drawings and instruction thus supplied will become a part of the Contract Documents. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions.

4.0 SCHEDULES, REPORTS AND RECORDS

4.1 The Contractor shall submit to the Owner payrolls, reports, estimates, records and other data where applicable as are required by the Contract Documents for the Work to be performed.

4.2 The Contractor, after the Contract award and prior to the Pre-Construction Conference, shall prepare for submittal to the Engineer for review, a detailed progress schedule. The progress schedule shall be brought up to date and submitted to the Engineer prior to each progress payment request, and at such other time intervals as the Engineer may request.

A. Progress Schedule

The schedule shall be a time-scaled critical path progress schedule showing in detail the proposed sequence of activity. The critical path analysis shall consist of a graphic network diagram and shall clearly show start and completion dates and percentage of work completed.

4.3 The Contractor shall also forward to the Engineer, prior to each progress payment request, an itemized report of the delivery status of major and critical items of purchased equipment and material, including Shop Drawings and the status of shop and field fabricated work. These progress reports shall indicate the date of the purchase order, the current percentage of completion, estimated delivery, and cause of delay, if any.

4.4 If the completion of any part of the Work or the delivery of materials is behind the approved schedule, the Contractor shall submit in writing a plan acceptable to the Engineer for bringing the Work up to schedule.

4.5 The Owner shall have the right to withhold progress payments for the Work if the Contractor fails to update and submit the progress schedule and reports as specified, and such withholding shall not constitute grounds for additional claims by the Contractor against the Owner.

4.6 The Contractor shall submit an estimated monthly cash flow, based upon the progress schedule with the bonds, schedules, and Certificate Of Insurance.

5.0 DRAWINGS AND SPECIFICATONS

5.1 The intent of the Drawings and Specifications is that the Contractor shall furnish all labor, materials, tools, equipment, utilities, and transportation necessary for the proper execution of the Work in accordance with the Contract Documents and all incidental work necessary to complete the Project in an acceptable quality and manner, ready for use, occupancy or operation by the Owner.

5.2 In case of conflict between the Drawings and Specifications, the Specifications shall govern. Figure dimensions on Drawings shall govern over scale dimensions, and detailed Drawings shall govern over general Drawings.

5.3 Any discrepancies found between the Drawings and Specifications and site conditions or any inconsistencies or ambiguities in the Drawings or Specifications shall be immediately reported verbally and within 24 hours of such a discovery, in writing to the Engineer, who shall promptly correct such inconsistencies or ambiguities in writing. Work done by the Contractor after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the Contractor's risk, and the Contractor shall assume full responsibility therefor and shall bear all costs attributable thereto, if not acceptable to the Owner.

6.0 SHOP DRAWINGS

6.1 The Contractor shall provide seven (7) copies of the Shop Drawings as specified or as may be necessary for the prosecution of the Work as required by the Contract Documents. All drawings and schedules shall be submitted sufficiently in advance to allow the Engineer not less than 20 regular working days for checking the submittal. The Engineer's approval of any Shop Drawings shall not release the Contractor from responsibility for deviations from the Contract Documents.

6.2 When submitted for the Engineer's review, Shop Drawings shall bear the Contractor's certification by means of a signed Stamp, that he has reviewed, checked and approved the Shop Drawings and that they are in conformance with the requirements of the Contract Documents. Shop Drawings, which in the opinion of the Engineer are incomplete or unchecked by the Contractor, will be returned to the Contractor for resubmission in the proper form.

If Shop Drawings or submittals are rejected by the Engineer, all costs incurred by the Engineer Or The Owner for reviewing the resubmittals shall be charged to the Contractor, and the Owner has the right to deduct such costs from any monies owed the Contractor by the Owner.

6.3 When Shop Drawings have been reviewed by the Engineer, two sets of submittals will be returned to the Contractor appropriately stamped. If major changes or corrections are necessary, the Shop Drawing may be rejected and one set will be returned to the Contractor with such

changes or corrections indicated, and the Contractor shall correct and resubmit the Shop Drawings. No changes shall be made by the Contractor to resubmitted Shop Drawings other than those changes indicated by the Engineer, unless such changes are clearly described in a letter accompanying the resubmitted Shop Drawings.

6.4 The review of such Shop Drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for corrections of dimensions, fabrication details, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the Contractor has called attention to such deviations in writing by a letter accompanying the Shop Drawings and the Engineer approves the change or deviation in writing at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the Shop Drawings. When the Contractor does call such deviations to the attention of the Engineer, the Contractor shall state in his letter whether or not such deviations involve any deduction or extra cost adjustment.

6.5 Portions of the Work requiring a Shop Drawing or sample submission shall not begin until the Shop Drawing or submission has been approved by the Engineer. A copy of each approved Shop Drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.

7.0 RECORD DRAWINGS

7.1 During construction, the Contractor shall keep an accurate record of the following:

A. Deviations between the Work as shown on the Plans and the Work as actually installed.

B. The specific locations of piping, valves, electric conduits, duct work, equipment, and other such work which was not located on the Plans. The Record Drawings shall show distances to these locations from known points on the Plans.

C. Equipment schedules indicating manufacturer's names and model numbers. When all revisions showing work as installed are made, the corrected set of plans shall be delivered to the Engineer before the final pay request is processed. These plans shall be clearly marked "Record Drawings."

7.2 Nothing contained in this section shall be construed as authorizing any deviation in the Work as shown on the Contract Drawings without a written Change Order or written authority to the Contractor from the Engineer.

8.0 MATERIALS, SERVICES, AND FACILITIES

8.1 It is understood that, except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the Work within

the specified time.

8.2 The Contractor shall furnish the Owner a list of materials and the source of supply of each of the materials on the list. The source of supply of each of the materials shall be approved by the Owner before the delivery of said materials is started. Only materials conforming to these Specifications and approved by the Owner shall be used in the Work. All materials proposed for use may be inspected or tested at any time during their preparation and use. After trial, if it is found that sources of supply which have been approved do not furnish a uniform product, or if the product from any source proves unacceptable at any time, the Contractor shall furnish approved material from other approved sources. No material which, after approval, has in any way become unfit for use shall be used in the Work.

8.3 The Contractor warrants to the Owner and Engineer that the materials and equipment furnished under the Contract will be new and of a quality equal to that specified or approved and, that all Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. Mechanical and electrical equipment shall be the products of manufacturers of established good reputations and regularly engaged in the fabrication of such equipment. Unless otherwise noted, any equipment offered shall be current models which have been in successful regular operation under comparable conditions for a period of at least two years. This time requirement, however, does not apply to minor details nor to thoroughly demonstrated improvements in design or in material of construction. Work shall be done and completed in a thorough and workmanlike manner and if required by Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment used.

8.4 All materials which the Engineer or its authorized Inspector has determined do not conform to the requirements of the Plans and Specifications will be rejected. They shall be removed immediately from the vicinity of the Work by the Contractor at his own expense, unless otherwise permitted by the Engineer. No rejected material, the defects of which have been subsequently corrected, shall be used in the Work, unless approval in writing has been given by the Engineer. Upon failure of the Contractor to comply promptly with any order of the Engineer made under the provisions in this section, the Engineer shall have authority to cause the removal and replacement of rejected material and to deduct the cost thereof from any monies due or to become due the Contractor.

8.5 If any part or portions of the Work done or material furnished under this Contract shall prove defective or non-conforming with the Drawings and Specifications, and if the imperfection in the same shall not be of sufficient magnitude or importance as to make the Work dangerous or unsuitable, or if the removal of such Work will create conditions which are dangerous or undesirable, the Engineer shall have the right and authority to retain such Work but shall make such deductions in the final payment therefor as may be just and reasonable. Such adjustment shall be effected whether or not final payment has been made.

8.6 Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the Work. Stored materials and equipment to be incorporated in the Work shall be located so as to facilitate prompt inspection.

8.7 Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

8.8 Materials, supplies or equipment to be incorporated into the Work shall not be purchased by the Contractor or the Subcontractor subject to a chattel mortgage or under a conditional sale contract or other Contract by which an interest is retained by the seller.

9.0 INSPECTION AND TESTING

9.1 All material and equipment used in the construction of the Project shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the Contract Documents.

9.2 The Owner shall provide all inspection and testing services not required by the Contract Documents.

9.3 The Contractor shall provide at its expense the testing and inspection services required by the Contract Documents.

9.4 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to specifically be inspected, tested, or approved by someone other than the Contractor, the Contractor will give the Engineer timely notice of readiness, the minimum of which shall be forty-eight (48) hours. The Contractor will then furnish the Engineer the required certificates of inspection, testing or approval.

9.5 Inspections, tests or approvals by the Engineer or others shall not relieve the Contractor from its obligations to perform the Work in accordance with the requirements of the Contract Documents.

9.6 The Engineer and its representatives will at all times have access to the Work. In addition, authorized representatives and agents of any participating Federal or State agency shall be permitted to inspect all Work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The Contractor will provide proper facilities for such access and observation of the Work and also for any inspection, or testing thereof.

9.7 If any Work is covered contrary to the written instructions of the Engineer or prior to inspection, if must, if requested by the Engineer, be uncovered for his observation and replaced at the Contractor's expense.

9.8 If the Engineer considers it necessary or advisable that Work that has already been approved be inspected or tested by the Engineer or others, the Contractor, at the Engineer's

request, will uncover, expose or otherwise make available for observation, inspection or testing as the Engineer may require, that portion of the Work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such Work is defective, the Contractor will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such Work is not found to be defective, the Contractor will be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate Change Order shall be issued.

10.0 SUBSTITUTIONS

10.1 Whenever a material, article or piece of equipment is identified on the Drawings or Specifications by reference to brand name or catalogue number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the Contract Documents by reference to brand name or catalogue number, and if, in the opinion of the Engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the Engineer may approve its substitution and use by the Contractor. Any cost differential shall be deductible from the Contract Price and the Contract Documents shall be appropriately modified by Change Order. The Contractor warrants that if substitutes are approved, no major changes in the function or general design of the Project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the Contract Price or Contract Time. Any substitutions not properly approved and authorized by the Engineer may be considered defective and the Engineer may require the Contractor to remove the substituted material, article or piece of equipment and the Contractor shall bear any and all costs associated with the removal of the substituted item, including all engineering, inspection, testing or surveying costs incurred by the Owner or the Engineer.

10.2 Determination of equality in reference to the project design requirements will be made by the Owner. "Equal" products shall not be purchased or installed by the Contractor without the Owner's written approval. Contractor shall have fourteen (14) days after issuance of Notice to Proceed for submission of data substantiating a request for substitution of an "or equal" item.

11.0 PATENTS

11.1 The Contractor shall pay all applicable royalties and license fees. The Contractor shall defend all suits or claims for infringement of any patent rights and indemnify and hold the Owner and Engineer harmless from loss on account thereof, except that the Owner shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified, however if the Contractor has reason to believe that the design, process or product specified is an infringement of a patent, it shall be responsible for such loss unless it promptly gives such information to the Engineer.

12.0 SURVEYS, PERMITS, REGULATIONS

12.1 The Owner shall furnish all boundary surveys and establish all base lines for locating the principal component parts of the Work together with a suitable number of bench marks adjacent to the Work as shown in the Contract Documents. The Contractor shall satisfy itself as to the accuracy of all measurements before constructing any permanent structure and shall not take advantage of any errors which may have been made in laying out the Work. From the information provided by the Owner, unless otherwise specified in the Contract Documents, the Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pile locations and other working points, lines, elevations and cut sheets.

12.2 Such stakes and markings as the Engineer may set for either its own or the Contractor's guidance shall be scrupulously preserved by the Contractor. In the event the Contractor, or its employees, destroy or otherwise remove or obliterate such stakes or markings, an amount equal to the cost of replacing the same may be deducted from subsequent estimates due the Contractor at the discretion of the Owner.

12.3 Permits and licenses of a temporary nature necessary for the prosecution of the Work shall be secured and paid for by the Contractor unless otherwise stated in the Supplemental General Conditions. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the Owner, unless otherwise specified. The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the Work as drawn and specified. If the Contractor perceives that the Contract Documents are at variance therewith, he shall promptly notify the Engineer in writing, and any necessary changes shall be adjusted as provided in Section 16. Changes In The Work. If the Contractor performs and works knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Engineer, he shall assume full responsibility therefore and shall bear all costs attributable thereto.

13.0 PROTECTION OF WORK, PROPERTY AND PERSONS

13.1 The Contractor shall have sole responsibility for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to, all employees on the Work and other persons who may be affected thereby, all the Work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and other items not designated for removal, relocation or replacement in the course of construction.

13.2 The Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. The Contractor shall erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety and protection. The Contractor shall notify Owners of adjacent utilities when prosecution of the Work may affect them. The Contractor shall remedy all damage, injury or loss to any property caused, directly or

indirectly, in whole or in part, by the Contractor, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except damage or loss attributable to the fault of the Contract Documents or to the acts or omissions of the Owner or the Engineer or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the Contractor.

13.3 In emergencies affecting the safety of persons or the Work or property at the site or adjacent thereto, the Contractor, without special instruction or authorization from the Engineer or Owner, shall act to prevent threatened damage, injury or loss. He shall give the Engineer prompt Written Notice of any significant changes in the Work or deviations from the Contract Documents caused thereby, and a Change Order shall thereupon be negotiated and issued covering the changes and deviations involved, as provided in Section 16.0, Changes in the Work.

13.4 The Contractor shall designate a responsible member of its organization at the site whose duty shall be the prevention of accidents and the safety of all those at the site. The person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and the Engineer. The Engineer will not be responsible for safety precautions and programs in connection with the Work or for the Contractor's failure to properly perform its responsibilities with respect to initiating, maintaining and supervising all safety precautions and programs.

14.0 PUBLIC SAFETY

14.1 Whenever the Contractor's operations create a condition hazardous to traffic or to the public, it shall furnish at its own expense, and without cost to the Owner, such flagmen and guards as are necessary to give adequate warning to the public of any dangerous conditions to be encountered and he shall furnish, erect, and maintain such fences, barricades, lights, signs, and other devices as are necessary to prevent accidents and avoid damage or injury to the public.

14.2 Should the Contractor appear to be neglectful or negligent in furnishing warning and protective measures as above provided, the Engineer may direct attention to the existence of a hazard and the necessary warning and protective measures shall be furnished and installed by the Contractor at its own expense without cost to the Owner. Should the Engineer point out the inadequacy of warning and protective measures, such action on the part of the Engineer shall not relieve the Contractor from responsibility for public safety or abrogate his obligation to furnish and pay for these devices.

14.3 Should the Contractor fail to, be neglectful, or be negligent in furnishing or maintaining warning and protective facilities as required herein, the Owner may furnish or maintain such facilities and charge Contractor therefor by deducting the cost thereof from periodic progress payments due the Contractor as such costs are incurred by Owner.

14.4 No material or equipment shall be stored where it will interfere with the free and safe passage of public traffic, and at the end of each day's Work and at other times when construction

operations are suspended for any reason, the Contractor shall remove all equipment and other obstructions from that portion of the right-of-way open for use by public traffic.

15.0 SUPERVISION BY CONTRACTOR

15.1 The Contractor shall supervise and direct the Work, using its best skill and attention. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor shall employ and maintain on the Work a qualified supervisor or superintendent who shall have been designated in writing by the Contractor as the Contractor's representative at the site, and who shall have been approved by the Engineer, which approval shall not be unreasonably withheld. The supervisor shall have full authority to act on behalf of the Contractor and all communications given to and by the supervisor shall be as binding as if given to and by the Contractor. The supervisor shall be present on the site at all times. The Contractor shall be responsible to the Owner for the acts and omissions of the employees, subcontractors, and the agents and employees, and other persons performing any other Work under the Contract with the Contractor.

16.0 CHANGES IN THE WORK

16.1 The Owner may at any time, as the need arises, order changes within the scope of the Work without invalidating the Contract. If such changes increase or decrease the amount due under the Contract Documents, or in the time required for performance of the Work, an equitable adjustment shall be authorized by Change Order.

16.2 The Engineer, also, may at any time, by issuing a Field Order, make changes in the details of the Work. The Contractor shall proceed with the performance of any changes in the Work so ordered by the Engineer unless the Contractor believes that such Field Order entitles him to a change in Contract Price or Time, or both, in which event he shall give the Engineer Written Notice thereof within seven (7) days after the receipt of the ordered change. Thereafter the Contractor shall document the basis for the change in Contract Price or Time within fourteen (14) days. The Contractor shall not execute such changes pending the receipt of an executed Change Order or further instruction from the Owner.

16.3 If the Contractor wishes to make a claim for an increase in the Contract sum, it shall give the Engineer written notice thereof within fourteen (14) days after the occurrence of the event giving rise to such claim. This notice shall be given by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property, in which case Contractor shall proceed in accordance with the provisions of the Contract. No such claim shall be valid unless so made. If the Owner and Contractor cannot agree on the amount of adjustment in the Contract sum, it shall be determined by the Engineer. Any change in the Contract sum resulting from such claim shall be authorized in a Change Order.

16.4 The value of any Work covered by a Change Order shall be determined by one or more of the following methods in the order of precedence listed below:

A. Unit prices previously approved.
B. An agreed lump sum.
C. Cost plus percentage.

17.0 TIME FOR COMPLETION AND LIQUIDATED DAMAGES

17.1 The date of beginning and the time for completion of the Work are essential conditions of the Contract Documents and the Work embraced shall be commenced on a date specified in the Notice To Proceed.

17.2 The Contractor shall proceed with the Work at such rate of progress to insure full completion within the Contract Time. It is expressly understood and agreed, by and between the Contractor and the Owner, that the Contract Time for the completion of the Work described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the Work.

17.3 The Contractor shall only work an eight (8) hour day consisting of Monday through Friday, between 6:00 a.m. to 6:00 p.m., and do not include local municipal holidays. If the Contractor desires to carry on Work more than eight (8) hours each day, or work at night or outside the regular hours, it shall give timely notice (72 hours) to the Engineer and receive the Owner's written approval to allow satisfactory arrangements to be made for inspecting the Work in progress. Should the prosecution of the Work be discontinued for any reason, the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations. The Contractor shall be responsible for any extra compensation due or costs incurred as a result of Contractor's desire to carry out Work beyond an eight (8) hour day, or at night or outside regular hours, including but not limited to, any additional costs or compensation due the Engineer And Owner or its employees or agents as a result of having to be present at the site. The costs or extra compensation necessitated by the Contractor's Work beyond an eight (8) hour day, or at night or outside regular business hours may be deducted or withheld from progress payment or any other payments due to Contractor.

17.4 If for any reason a suspension of the work should occur; the Contractor, at its own expense, shall do all the Work necessary to provide a safe, smooth and unobstructed passageway through construction for use by public traffic or to provide for the proper and efficient operation of sewer, drainage and other facilities within the site of the Work, during the period of such suspension. In the event that the Contractor fails to perform the Work specified in this Subsection, the Owner will perform such Work and the cost thereof will be deducted from periodic progress payments due the Contractor.

17.5 During inclement weather and other conditions, the Contractor shall pursue only such portions of the Work as shall not be damaged thereby. No portions of the Work which satisfactory quality or efficiency will be affected by an unfavorable condition shall be constructed while these conditions remain, unless by special means or precautions, approved by the Engineer, the Contractor is able to overcome them.

17.6 Delays in delivery of equipment or material purchased by the Contractor or its Subcontractor, including Engineer-selected equipment, shall not be considered as a just cause for delay as this is not beyond the control of the Contractor. The Contractor shall be fully responsible for the timely ordering, scheduling, expediting, delivery, and installation of all equipment and materials.

17.7 In case of failure on the part of the Contractor to complete the Work within the time affixed in the Contract, or such extension thereof as may be allowed by Engineer or Owner, the Contract shall by that fact be terminated by written notice. The Owner shall not thereafter pay or allow the Contractor any further compensation for any Work done by it under said Contract, and the Contractor and its sureties shall be liable to the Owner for all loss or damage which it may suffer by reason of his failure to complete the Contract within such time. Failure to prosecute the Work diligently shall be grounds for termination by the Owner pursuant to this paragraph.

In the event the Contract should be terminated, the Owner shall have the right to take over the Work and to proceed with the same until it is completed, either by performing said Work itself directly or by contracting it out to some other person or persons, and in such event the Owner may take possession of and utilize, in completing the Work, such materials, appliances and plant as may be on the site of the Work and necessary for its completion. Nothing herein contained shall be deemed to limit the right of the Owner in the event of any breach of Contract by the Contractor; but all rights herein given to the Owner are and shall be deemed to be additional to any other rights or remedies which the Owner shall have under any provision of law.

17.8 Should the Contractor fail to complete the Work, or any part thereof, in the time agreed upon in the Contract or within such extra time as may have been allowed for delays by extensions granted as provided in the Contract, the Contractor shall reimburse the Owner for the additional expense and damage for each calendar day that the Contract remains uncompleted after the Contract completion date. It is agreed that the amount of such additional expense and damage incurred by reason of failure to complete the Work is the per diem rate, as stipulated in Section 15, Information For Bidders, plus any costs incurred by the Engineer including, but not limited to: the Engineer's costs for additional inspection, testing or surveying as a result of the Contractor's failure to complete the Work in the time agreed upon. The said amounts are agreed upon as liquidated damages for the loss to the Owner on account of expense due to the employment of Engineers, inspectors, and other employees after the expiration of the time of completion, and on account of the value of the operation of the Works dependent thereon. It is expressly understood and agreed that this amount is not to be considered in the nature of a penalty, but as liquidated damages which have accrued against the Contractor. The Owner shall have the right to deduct such damages from any amount due, or that may become due the Contractor, or the amount of such damages shall be due and collectible from the Contractor or its Surety.

17.9 The Contractor shall not be charged with liquidated damages or any excess costs when the delay in completion of the Work is due to any of the reasons set forth below provided the Contractor has given Written Notice of the delay within three (3) days of the occurrence of the cause of the delay to the Owner or Engineer. In the event notice is not given as provided, liquidated damages may be assessed.

A. To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to: acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a separate contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather.

18.0 CORRECTION OF WORK

18.1 The Contractor shall promptly correct all work rejected by the engineer as defective or as failing to conform to the contract documents, whether observed before or after substantial completion and whether or not fabricated, installed or completed. Contractor shall bear all costs of correcting such rejected work, including compensation for the engineer's additional services made necessary thereby. Contractor shall also bear the costs of making good all work of the Owner or separate Contractor destroyed or damaged by such correction or removal.

18.2 All removal and replacement work shall be done at the Contractor's expense. If the Contractor does not take action to remove such rejected work within ten (10) days after receipt of Written Notice, the Owner may remove such work and store the materials at the expense of the Contractor, including compensation for the engineer's additional services made necessary thereby.

19.0 SUBSURFACE CONDITIONS

19.1 The Contractor shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the Owner by Written Notice of:

A. Subsurface or latent physical conditions at the site differing materially from those indicated in the Contract Documents; or

B. Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in Work of the character provided for in the Contract Documents.

19.2 The Owner shall promptly investigate the conditions, and if it finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the Work, an equitable adjustment shall be made and the Contract Documents shall be modified by a Change Order. Any claim of the Contractor for adjustment hereunder shall not be allowed unless he has given the required Written Notice; provided that the Owner may, if he determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

20.0 SUSPENSION OF WORK, TERMINATION AND DELAY

20.1 The Owner may suspend the Work or any portion thereof for a period of not more than

ninety (90) days or such further time as agreed upon by the Contractor, by Written Notice to the Contractor and the Engineer which notice shall fix the date on which Work shall be resumed. The Contractor shall resume that Work on the date so fixed. The Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension.

20.2 In addition to any other reasons for termination provided in the Contract, the Contractor shall be considered in default of the Contract and such default will be considered as cause for the Owner to terminate the Contract for any of the following reasons if the Contractor:

A. Fails to begin the Work under the Contract within the time specified in the "Notice To Proceed," or

B. Fails to perform the Work or fails to provide sufficient workers, equipment or materials to assure completion of Work in accordance with the terms of the Contract, or

C. Performs the Work unsuitably or neglects or refuses to remove materials or to perform such new Work as may be rejected as unacceptable and unsuitable, or

D. Discontinues the prosecution of the Work, or

E. Fails to resume Work which has been discontinued within a reasonable time after notice to do so, or

F. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or

G. Allows any final judgment to stand against him unsatisfied for a period of 10 days, or

H. Makes an assignment for the benefit of creditors, or acceptable manner, or

I. Is otherwise in breach of the Contract and has failed to remedy the breach within ten (10) days of written notice of the existence of such breach, or

J. Fails to provide safe conditions for its workers and/or the general public.

Should the Owner consider the Contractor in default of the Contract for any reason above, he shall immediately give Written Notice to the Contractor and the Contractor's surety as to the reasons for considering the Contractor in default and the Owner's intentions to terminate the Contract.

If the Contractor or Surety, within a period of 10 days after Written Notice, does not proceed in accordance therewith, then the Owner shall have, upon written notification of the facts of such

delay or neglect, the power and authority without violating the Contract, to take the prosecution of the Work out of the hands of the Contractor. The Owner may appropriate or use any or all materials and equipment that have been mobilized for use in the Work and are acceptable and may enter into an Contract for the completion of said Contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Owner will be required for the completion of said Contract in an acceptable manner.

All costs and charges incurred by the Owner, together with the cost of completing the Work under Contract, will be deducted from any monies due or which may come due the Contractor. If such expense exceeds the sum which would have been payable under the Contract, then the Contractor and the Surety shall pay to the Owner the amount of such excess.

20.3 Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of monies due Contractor by Owner will not release Contractor from liability.

20.4 Upon seven days Written Notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, elect to terminate the Contract. In such case, Contractor shall be paid (without duplication of any items):

20.4.1 for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such work;

20.4.2 for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead on such expenses;

20.4.3 for reasonable costs incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and

20.4.4 for reasonable expenses directly attributable to termination.

Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

20.5 If the Work should be stopped under an order of any court or other public authority for a period of more than ninety (90) days, through no act or fault of the Contractor or of anyone employed by him, or if the Owner should fail to pay the Contractor within 45 days after the time specified in the Payments To Contractor, Section 22.0, then the Contractor may, upon 15 days Written Notice to the Owner, stop Work until payment of the amount owing has been received.

20.6 The Owner may terminate the Contract or a portion thereof if conditions encountered during the progress of the Work make it impossible or impracticable to proceed with the Work or

a local or national emergency exists.

When Contracts, or any portion thereof, are terminated before completion of all Work in the Contract, adjustments in the amount bid for the pay items will be made on the actual quantity of Work performed and accepted, or as mutually agreed for pay items of Work partially completed or not started. No claim for loss of anticipated profits will be considered.

Termination of the Contract or any portion thereof shall not relieve the Contractor of its responsibilities for the completed work nor the surety of its obligation for and concerning any just claims arising out of the Work performed.

21.0 ISSUANCE OF NOTICE OF COMPLETION AND FINAL ACCEPTANCE BY OWNER

21.1 Upon completion of the Project, a Final Inspection shall be requested by the Contractor in writing and the Owner will make an inspection within seven (7) days. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection and the Owner will make the final acceptance and issue a Certificate Of Completion to the Contractor.

If, however, the inspection discloses any Work, in whole or in part, as being unsatisfactory, the Owner will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the Work, another inspection will be made which shall constitute the final inspection provided the Work has been satisfactorily completed. In such event, the Owner will make the final acceptance and issue a Certificate Of Completion to the Contractor.

22.0 PAYMENTS TO CONTRACTOR

22.1 In addition to any documents required by the Engineer to be submitted to Engineer at the time a partial pay estimate is submitted, including partial lien released as specified in Section 22.9 of the General Conditions*,* the Contractor shall, at least ten (10) days before each progress payment falls due (but not more often than once a month), submit to the Engineer a partial payment estimate filled out and signed by the Contractor covering the Work performed during the period covered by the partial payment estimate and supported by such data as the Engineer may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the Work, title to such materials and equipment shall vest in the Owner, and Contractor shall supply, at the time of submission of payment estimate, supporting documents satisfactory to the Owner, to establish and protect Owner's interest in the materials and equipment, and Contractor shall maintain appropriate insurance on same until such time as actual possession by the Owner of the materials and equipment shall occur. The Engineer will, within seven (7) days after receipt of each partial payment estimate, either indicate in writing his approval of payment and present the partial payment estimate to the Owner or return the partial payment estimate to the Contractor indicating in writing his reasons for refusing to approve payment. In the latter case, the Contractor may make the necessary corrections and resubmit the partial payment estimate. The Owner will, within fourteen (14) days of presentation to him

of an approved partial payment estimate, pay the Contractor a progress payment on the basis of the approved partial payment estimate. The Owner shall retain ten (10) percent of the amount of each payment until final completion and acceptance of all Work covered by the Contract Documents. When the Contract is fifty percent completed, one-half of the amount retained shall be paid to the Contractor provided the Contractor makes a written request for the payment and the Contractor is making satisfactory progress on the Contract and there is no specific cause or claim requiring a greater amount to be retained. After the Contract is fifty per cent completed, no more than five per cent of the amount of any subsequent progress payments made under the Contract may be retained providing the Contractor is making satisfactory progress on the project, except that if at any time the Owner determines satisfactory progress is not being made, ten per cent retention shall be reinstated for all progress payments made under the Contract subsequent to the determination.

22.2 In lieu of ten percent (10%) retention provided for in paragraph 22.1, of this Article, the Owner shall, at the Contractor's option, accept as a substitute an assignment of any of the following:

A. Time certificates of deposit of banks licensed by the State of Arizona; or

B. Securities of or guaranteed by the United States of America; or

C. Securities of the State of Arizona, or any county, municipality or school district thereof; or

D. Shares of savings and loan institutions authorized to transact business in the State of Arizona.

Such assigned instruments shall have a face value in an amount equal to ten percent (10%) of the progress payment for which such instruments are tendered and shall be retained by the Owner as a guarantee for complete performance of the Contract.

In the event the Owner accepts substitute security as provided herein for the ten percent (10%) retention, the Contractor shall be entitled to all interest or income earned by such security, and all such security in lieu of retention shall be returned to the Contractor within sixty (60) days after final completion and acceptance of all material, equipment and work covered by the contract if the Contractor has furnished the Owner satisfactory receipts for all labor and material billed and waivers of liens from any and all persons holding claims against the work.

In no event shall the Owner accept a time certificate of deposit of a bank or shares of a savings and loan institution in lieu of the retention specified in paragraph 22.1 of this Article unless accompanied by a signed and acknowledged waiver of the bank or savings and loan institution of any right or power to set off against either the Owner or the Contractor in relationship to the certificates or shares assigned.

22.3 The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the

Owner out of the amount paid to the Contractor on account of such Subcontractors' Work, the amount to which said Subcontractor is entitled, reflecting the percentage actually retained, if any, from payments to the Contractor on account of such Subcontractors' Work. The Contractor shall, by an appropriate Contract with each Subcontractor, require each Subcontractor to make payments to his Sub-subcontractors in similar manner.

22.4 Prior to Substantial Completion, the Owner, with the approval of the Engineer and with the concurrence of the Contractor, may use any completed or substantially completed portions of the Work. Such use shall not constitute an acceptance of such portions of the Work.

22.5 The Owner shall have the right to enter the premises for the purpose of doing Work not covered by the Contract Documents. This provision shall not be construed as relieving the Contractor of the sole responsibility for the care and protection of the Work, or the restoration of any damaged Work except such as may be caused by agents or employees of the Owner.

22.6 Upon final completion and acceptance of the Work, the Engineer shall issue a certificate attached to the final payment request that the Work has been accepted under the conditions of the Contract Documents. No retention of payments may be delayed or retained without a specific written finding by the Engineer or Owner of the reasons justifying the delay in payment. The entire balance found to be due the Contractor, including the retained percentages, except the amount necessary to pay the expenses the Owner reasonably expected to incur in order to pay or discharge the expenses determined by the Engineer or Owner in the finding justifying the retention or delay, shall be paid to the Contractor, within sixty (60) days of completion or proper filing of the Notice of Completion.

22.7 The Contractor shall indemnify and save the Owner or the Owner's agents harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the Work. The Contractor shall, at the Owner's request, furnish satisfactory evidence, in the form of lien releases or other documents deemed appropriate by the Owner***,*** that all obligations of the nature designated above have been paid, discharged, or waived. If the Contractor fails to do so the Owner may, after having notified the Contractor, either pay unpaid bills or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of the Contract Documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor, his Surety, or any third party. In paying any unpaid bills of the Contractor, any payment so made by the Owner shall be considered as a payment made under the Contract Documents by the Owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments made in good faith.

22.8 If any payment to Contractor is delayed after the date due, interest shall be paid at the rate of one percent per month or fraction of a month on such unpaid balance as may be due. If the Owner fails to make payment sixty (60) days after final completion and acceptance, in addition

to other remedies available to the Contractor, interest shall be paid at the rate of one per cent per month or fraction of the month on such unpaid balance as may be due, except for that amount necessary to pay the expenses the Owner reasonably expects to incur in order to pay or discharge the expense determined by the Engineer or Owner in the finding justifying the retention or delay.

22.9 The Owner may require the Contractor to furnish partial releases or liens executed by all persons, firms and corporations who have furnished labor services or materials incorporated into the Work during the period of time for which the progress payment is due, releasing such lien rights as these persons, firms or corporations may have for that period.

23.0 ACCEPTANCE OF FINAL PAYMENT AS RELEASE

23.1 Following the Owner's acceptance of the Work, the Owner will issue a Notice of Completion to the Contractor. Sixty days after the issuing of the Notice of Completion, and upon receipt of the necessary Unconditional lien releases executed by all persons, firms and corporations who have furnished labor services or materials incorporated into the work evidencing that all liabilities have been fully discharged, the Owner will pay to the Contractor the entire sum so found to be due after deducting therefrom all previous payments and all amounts to be kept and all amounts to be retained under the provisions of the Contract. All previous prior partial estimates and payments shall be subject to correction in the final estimate and payment.

23.2 The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or furnished in connection with this Work and for every act and neglect of the Owner and others relating to or arising out of this Work. Any payment, however, final or otherwise, shall not release the Contractor or his sureties from any obligations under the Contract Documents or the Performance Bond and Payment Bonds.

24.0 INSURANCE

24.1 The Contractor shall give special attention to Section 00500-A of the Bid Documents when preparing a bid, which outline the insurance requirements of Owner and the Contractor shall consider these insurance requirements part of the Bid/Contract documents.

The Contractor shall purchase and maintain such insurance as will protect him from claims set forth below which may arise out of or result from the Contractor's execution of the Work, whether such execution be by itself or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

A. Claims under worker's compensation, disability benefit and other similar employee benefit acts;

B. Claims for damages because of bodily injury, occupational sickness or disease, or death of his employees;

C. Claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees;

D. Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by any other person; and

E. Claims for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom.

The Contractor is responsible to respond to claims arising as a result of its work. See Section 500-B for specific procedures.

24.2 Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These Certificates shall contain a provision that coverages afforded under the policies will not be canceled unless at least ten (10) days prior Written Notice has been given to the Owner, "Attention: Contract Administrator, 2330 McCulloch Boulevard North, Lake Havasu City, AZ, 86403".

24.3 The Contractor shall procure and maintain, at its own expense, during the Contract Time, liability insurance as specified in Section 500-A, incorporated herein.

25.0 CONTRACT SECURITY

25.1 The Contractor shall within ten (10) days after the receipt of the Notice Of Award furnish the Owner with a Performance Bond and a Payment Bond in sums equal to the amount of the Contract PRICE, conditioned upon the performance by the Contractor of all undertakings, covenants, terms, conditions and Contracts of the Contract Documents, and upon the prompt payment by the Contractor to all persons supplying labor and materials in the prosecution of the Work provided by the Contract Documents. Such Bonds shall be executed by the Contractor and a corporate bonding company licensed to transact such business in the state in which the Work is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these Bonds shall be borne by the Contractor. If at any time a surety on any such Bond is declared a bankrupt or loses its right to do business in the state in which the Work is to be performed or is removed from the list of Surety Companies accepted on Federal Bonds, Contractor shall within ten (10) days after notice from the Owner to do so, substitute an acceptable Bond (or Bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such Bond shall be paid by the Contractor. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable Bond to the Owner.

26.0 ASSIGNMENTS

26.1 Neither the Contractor nor the Owner shall sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of his right, title or interest therein, or his obligations thereunder, without written consent of the other party. Nor shall the Contractor assign any monies due or to become due to him hereunder without the previous written consent of the Owner.

26.2 The Owner and Contractor each bind itself, its partners, successors and assigns and legal representatives to the other party hereto and to the partners, successors, assigns and legal representatives of such other party in respect to all covenants, Contracts and obligations contained in the Contract Documents.

27.0 INDEMNIFICATION

27.1 Contractor shall indemnify and hold harmless City, its officers and employees from and against any and all liabilities, damages, losses, and costs, including reasonable attorney's fees, but only to the extent caused by the negligence, recklessness, or intentional wrongful conduct of Contractor or other persons employed or used by the Contractor in the performance of this Contract. It is agreed that Contractor will be responsible for primary loss investigation, defense, and judgment costs where this indemnification is applicable.

27.2 In any and all claims against the Owner or the Engineer, or any of their agents or employees, by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation of benefits payable by or for the Contractor or any Subcontractor under worker's compensation acts, disability benefit acts or other employee benefits acts.

27.3 The obligation of the Contractor under this paragraph shall not extend to the liability of the Engineer, his agents or employees arising out of the preparation or approval of maps, DRAWINGS, opinions, reports, surveys, Change Orders, designs or Specifications.

28.0 SEPARATE CONTRACTS

28.1 The Owner reserves the right to let other contracts in connection with this Project. The Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and the execution of their Work, and shall properly connect and coordinate its Work with theirs. If the proper execution or results of any part of the Contractor's Work depends upon the Work of any other Contractor, the Contractor shall inspect and promptly report to the Engineer any defects in such Work that render it unsuitable for such proper execution and results.

28.2 The Owner may perform additional Work related to the Project by itself, or it may let other contracts containing provisions similar to these. The Contractor shall afford the other Contractors who are parties to such Contracts (or the Owner, if he is performing the additional Work himself),

reasonable opportunity for the introduction and storage of materials and equipment and the execution of Work, and shall properly connect and coordinate his Work with theirs.

28.3 If the performance of additional Work by other Contractors or the Owner is not noted in the Contract Documents prior to the execution of the Contract, written notice thereof shall be given to the Contractor prior to starting any such additional Work. If the Contractor believes that the performance of such additional Work by the Owner or others involves it in additional expense or entitles him to an extension of the Contract Time, it may make a claim therefore as provided in Sections 16 and 17.

29.0 SUBCONTRACTING

29.1 The Contractor may utilize the services of specialty Subcontractors on those parts of the Work which come under normal contracting practices or are typically performed by specialty Subcontractors, provided the Contractor, simultaneously with the delivery of the executed Contract, shall furnish to the Owner and the Engineer in writing the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. The engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Engineer, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Engineer to promptly reply shall constitute notice of no reasonable objection. The Contractor shall not contract with any such proposed person or entity to whom the Owner or Engineer has made reasonable objection and the Contractor shall not be required to contract with anyone to whom he has a reasonable objection. If the Owner or Engineer has a reasonable objection to any proposed person or entity, the Contractor shall submit a substitute to whom the Owner or the Engineer has no reasonable objection. The Contractor shall make no substitution for any Subcontractor, person or entity previously selected if the Owner or Engineer makes reasonable objection to such substitution.

29.2 The Contractor shall not award Work to Subcontractor(s), in excess of forty-nine (49%) percent of the Contract Price, without prior written approval of the Owner.

29.3 The Contractor shall be fully responsible to the Owner for the acts and omissions of its Subcontractors, and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it.

29.4 The Contractor shall not employ any Subcontractors that are not properly licensed with Lake Havasu City and the State of Arizona. Changes of Subcontractors listed with the Proposal shall be made only with the approval of the Owner.

29.5 Nothing contained in these Contract Documents shall be construed as creating any contractual relationship between any Subcontractor and the Owner; the Contractor shall be as fully responsible to the Owner for the acts and omissions of Subcontractors, and of persons employed by them, as he is for the acts and omissions of persons directly employed by him.

29.6 The Contractor shall, without additional expense to the Owner, utilize the services of specialty Subcontractors on those parts of the Work which are specified or required by State or local laws to be performed by specialty Subcontractors.

29.7 The Contractor shall be responsible for the coordination of all trades, Subcontractors, material and people engaged upon this Work. The Owner will not undertake to settle any differences between the Contractor and his Subcontractors or between Subcontractors.

29.8 The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind Subcontractors to the Contractor by the terms of the Contract Documents insofar as applicable to the Work of Subcontractors and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract Documents.

29.9 Nothing contained in this Contract shall create any contractual relation between any Subcontractor and the Owner.

30.0 ENGINEER'S AUTHORITY

30.1 The Engineer shall act as the Owner's representative during the construction period. The Engineer shall decide questions which may arise as to quality and acceptability of materials furnished and Work performed and shall interpret the intent of the Contract Documents in a fair and unbiased manner. The Engineer will make periodic visits to the site and determine if the Work is proceeding in accordance with the Contract Documents.

30.2 The Contractor will be held strictly to the intent of the Contract Documents in regard to the quality of materials, workmanship and execution of the Work. Inspections may be made at the factory or fabrication plant of the source of material supply.

30.3 The Engineer shall not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety precautions and programs in connection with the Work and will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Engineer shall not be responsible or have control or charge over the acts or omissions of the Subcontractors, or any of their agents or employees, or any other person performing any of the Work.

30.4 The Engineer shall promptly make decisions relative to interpretation of the Contract Documents.

30.5 The Engineer will have the authority to reject Work which does not conform to the Contract Documents. Whenever, in its opinion, it is considered necessary or advisable for the implementation of the intent of the Contract Documents, the Engineer will have authority to require special inspection or testing of the Work in accordance with the other terms of this Contract whether or not such Work be then fabricated, installed or completed.

31.0 LAND AND RIGHTS-OF-WAY

31.1 Prior to issuance of Notice To Proceed, the Owner shall obtain all land and rights-of-way necessary for carrying out and for the completion of the Work to be performed pursuant to the Contract Documents, unless otherwise mutually agreed.

31.2 The Owner shall provide to the Contractor information which delineates and describes the lands owned and rights-of-way acquired.

31.3 The Contractor shall provide at its own expense and without liability to the Owner any additional land and access thereto that the Contractor may desire for temporary construction facilities, or for storage of materials.

32.0 GUARANTEE

32.1 Except as otherwise specified, all Work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, equipment, or workmanship for a period of one (1) year from the date the Certificate of Substantial Completion is issued by the Owner, or within such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents.

32.2 If, within any guarantee period, repairs or changes are required in connection with guaranteed Work, which, in the opinion of the Owner, is rendered necessary as the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, the Contractor shall, promptly upon receipt of notice from the Owner, and without expense, (1) place in satisfactory condition in every particular all of such guaranteed Work, correcting all defects therein; (2) make good all damage to the building, site or Work, or equipment or contents thereof, which in the opinion of the Owner, is the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the contract; and (3) make good any Work or material, or the equipment and contents of said building, site or Work disturbed in fulfilling any such guarantee. If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected and the Contractor and his surety shall be liable for all expense incurred. The Performance Bond shall remain in full force and effect through the guarantee period.

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GUARANTEE

The Contractor agrees to execute, and to cause each Subcontractor to execute, a written guarantee to the Owner, in substantially the following form:

GUARANTEE FOR:

We hereby guarantee, both jointly and severally, that the improvement which we have installed for the Owner of Project, specifically described as:

Water Treatment Plant Improvements Project,
Project No. B26-PW-108025-500707

has been done in accordance with the Contract Drawings and Specifications.

We agree, both jointly and severally, to repair and replace any or all Work included in said improvement, together with any other adjacent work which may be displaced or damaged by so doing, that may prove to be defective in its workmanship or material within a period of one year from date of the Certificate of Substantial Completion, ordinary wear and tear and unusual abuse or neglect accepted.

In the event of our failure to comply with the above mentioned conditions within a reasonable period of time (as determined by the Owner) after being notified in writing by the Owner, we both jointly and severally, do hereby authorize the Owner to proceed to have said defects repaired and made good at our expense, and we will honor and pay the costs and charges therefore upon demand.

Signed _____

Countersigned _____

Local Representative to be contacted for service:

Name _____

Address _____

Phone No. _____

FAX _____

The guarantee form(s) shall be completed and returned with the acknowledgement of the Certificate of Completion.

The failure of the Contractor or any Subcontractor to execute, such guarantee shall not affect the right of the Owner to rely on and enforce the guarantee and the obligations respectively assumed by the Contractor and each Subcontractor under Subparagraph 32.1 and 32.2 hereof.

33.0 ARBITRATION

33.1 Provided both parties mutually agree, all claims, disputes and other matters in question arising out of, or relating to, the Contract Documents or the breach thereof, except for claims which have been waived by the making and acceptance of final payment as provided by Section 23, may be decided by arbitration in accordance with the American Arbitration Association or any other similar body. The foregoing Contract to arbitrate shall be specifically enforceable under the prevailing arbitration law (Arizona Revised Statutes Sections 12-1501, *et seq*.) of the State of Arizona. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.

33.2 Notice of the demand for arbitration shall be filed in writing with the other party to the Contract Documents and with the American Arbitration Association and a copy shall be filed with the Engineer. The party filing for arbitration may select which arbitration service to use. Demand for arbitration shall in no event by made on any claim, dispute or other matter in question which would be barred by the applicable statute of limitations.

33.3 The Contractor shall carry on the Work and maintain the progress schedule during any arbitration proceedings, unless otherwise mutually agreed in writing.

33.4 The provisions of the Contract pertaining to arbitration are not binding upon Engineer and Engineer cannot be compelled to participate against his will in an arbitration arising out of a dispute over the Contract or Contract Documents unless Engineer so consents in writing to be a party to the arbitration.

34.0 TAXES AND CHARGES

34.1 The Contractor shall pay all State and local sales and use taxes on items, and in a manner as required by the laws and statutes of the State of Arizona and its political subdivisions. The Contractor shall withhold and pay any and all withholding taxes, whether State or Federal, and pay all Social Security charges, State Unemployment Compensation charges, industrial insurance, workers' compensation charges, and pay or cause to be withheld, as the case may be, any and all taxes, charges, or fees, or sums whatsoever, which are now or may hereafter be required to be paid or withheld under any laws.

35.0 MISCELLANEOUS CONDITIONS

35.1 In the event that either party to the Contract is required to institute arbitration or litigation to enforce its rights under the terms of the Contract, then the prevailing party in the arbitration or litigation shall be entitled to recover all costs and attorney's fees incurred.

35.2 In the event that any provision contained in the Contract is found to be contrary to the applicable law, then it shall be severed and the remaining provisions of the Contract shall remain in full force and effect.

35.3 The Contract shall be governed by the laws of the State of Arizona.

36.0 CONFLICTS WITHIN THE PLANS OR SPECIFICATIONS

36.1 In the event that a conflict is discovered between sections of the Specifications or between the Plans and the Specifications, the following list of priority shall be used to resolve the conflict:

A. Executed Change Orders
B. Addenda
C. Contract
D. Special Provisions
E. General Conditions
F. Instructions to Bidders
G. Technical Specifications
H. Plans
I. Referenced Standard Specifications or Other Documents

37.0 NONDISCRIMINATION

37.1 The Contractor, with regard to the work performed pursuant to this contract, shall not discriminate on the grounds of race, color, sex, religion, creed, age, physical or mental disability, or national origin or ancestry in any contracts with the public and in the selection and retention of employees or subcontractors, nor in the procurement of materials and leases of equipment.

38.0 INTEGRATION

38.1 This Contract represents the entire Contract between the parties hereto and supersedes any and all prior negotiations or representations, either written or oral.

38.2 Amendments or modifications to the Contract shall be in writing, signed by both parties, or by Change Orders.

38.3 The Contract Documents shall not be construed to create any contractual relationship of any kind between the Engineer and the Contractor, but the Engineer shall be entitled to performance of obligations intended for his benefit, and to the enforcement thereof.

39.0 HAZARD COMMUNICATION PROGRAM

39.1 All contractors working on City projects shall submit a copy of their hazard communication plan to the Fire Prevention Office prior to commencement of work on any project. This will ensure that other individuals on the job site are not unknowingly exposed to a hazardous substance or chemical.

The Fire Prevention Office shall be provided a list of the hazardous substances and the material safety data sheets that are applicable to the work areas of those contract employees.

All contract labor within City facilities will be treated the same as regular employees with regard to this hazard communication standard.

** END OF SECTION **

LAKE HAVASU CITY

SPECIAL PROVISIONS

AND

TECHNICAL SPECIFICATIONS

Water Treatment Plant Improvements Project, Project No. B26-PW-108025-500707

SECTION 00800
SPECIAL PROVISIONS

1.0 SCOPE

These Special Provisions supplement and modify the General Conditions, Technical Specifications, and Plans. All requirements and provisions of the General Conditions, Technical Specifications and Plans apply except where modified by these Special Provisions.

2.0 DEFINITION OF TERMS

Wherever in these documents the word "Engineer" appears, it shall be understood to mean Lake Havasu City Public Works Department, Engineering Division.

3.0 PRECONSTRUCTION CONFERENCE

Within ten (10) days after the Contract has been awarded, but before the start of construction, the Engineer will schedule a conference to be held at the site of the Project for the purpose of discussing such matters as Project supervision, onsite inspections, progress schedules and reports, payrolls, payments to Contractors, equal employment opportunity, contract change orders, insurance, safety, and any other items pertinent to the Project. The Contractor shall arrange to have all supervisory personnel connected with the Project on hand to meet with the representatives of the Owner and the Engineer.

4.0 DRAWINGS OF RECORD

Two sets of the Contract Documents are to be kept at the job site, maintained in good condition, and marked daily by the Contractor as the Work proceeds. The Contract Documents shall be kept available for inspection by the Owner at all times, and shall be kept up to date.

5.0 SURVEYS

The CONTRACTOR shall layout the WORK, in accordance with the drawings, shall establish all necessary lines, etc., required to complete the Work in accordance with the Contract Documents. The CONTRACTOR shall employ an experienced and competent Arizona Registered Land Surveyor (R.L.S.) satisfactory to the Owner to layout the WORK and to verify lines and elevations as the WORK progresses.

6.0 WEATHER CONDITIONS

In the event of temporary suspension of Work, or during inclement weather, or whenever the Owner shall direct, the Contractor will and will cause its Subcontractors to protect carefully their Work and materials against damage or injury from the weather. If, in the opinion of the Owner, any Work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or any of its Subcontractors to so protect its work, such materials shall be removed and replaced at the expense of the Contractor.

7.0 SUBMITTALS

Prior to construction and as soon as possible, the Contractor shall supply all submittals required by the Technical Specifications or as requested by the Owner.

8.0 INSPECTION OF THE WORK

The Owner intends to provide a full-time resident inspector for the Project. The resident inspector will be available for a forty (40) hour period during the week from Monday through Friday during the period of the Contract. In the event the Contractor elects to work outside the forty (40) hour week that occurs between Monday through Friday, such as Saturday, Sunday or legal holidays, in accordance with Article 17.0 of the General Conditions the Contractor will be responsible for all inspection, engineering, and testing costs incurred during that period. For any inspection work performed on Saturday, Sunday, or local municipal holidays the minimum chargeable time shall be four (4) hours. The Owner reserves the right to deduct these additional inspection, engineering, and testing costs directly from the Contractor's payments.

9.0 WATER AND POWER

A. WATER

Water is available from the Water Division at no cost to the Contractor. The Contractor shall make application and obtain a hydrant meter from the Water Division for the purpose of metering the use of water on the Project. The Contractor shall adhere to all conditions stated in the Meter Application, including payment of a deposit for the meter, return of the meter to the Water Division each month during the Project for reading, and notification to the Water Division prior to any change in the location of the hydrant meter. The maximum water to be drawn off a hydrant at any time is 200 gpm (water drawn from 4" hydrant whenever available). Water shall only be drawn off hydrants approved by the Lake Havasu City Water Superintendent or authorized representative.

B. POWER

All power for lighting, operation of Contractor's plant or equipment or for any other use as may be required for proper completion of the Work to be performed under the provisions of these Contract Documents, shall be provided by the Contractor

at its sole cost and expense.

10.0 BURNING OF VEGETATION

No burning of vegetation will be allowed.

11.0 MATERIALS TESTING

A. CONSTRUCTION TESTING

All quality control testing must be provided by Contractor. The material and workmanship provided during construction will be tested on a regular basis by the Contractor. It shall be the responsibility of the Contractor, at no additional cost, to provide material samples for testing at the **Owner's** request.

The Contractor shall be responsible for charges resulting from failed tests, costs for retesting shall be based upon hourly and/or individual test rates. In the event any portion of the Project is rejected because of substandard work, all materials testing, engineering, and inspection costs associated with corrective measures shall be chargeable to the Contractor at the current respective rates.

B. PRELIMINARY MATERIALS TESTING

All preliminary materials testing and mix design testing required by the Specifications to ensure materials and mix designs are suitable for Project use will be the responsibility of the Contractor at no additional cost to the Owner.

12.0 CLEANUP AND POLLUTION CONTROL

A. GENERAL

The Contractor shall be responsible for the removal of all debris, litter and waste from the job site(s) and/or equipment maintenance area and the restoration of any and all areas affected, directly or indirectly by the construction, transportation of equipment or materials and/or by the acts of neglect or omission by its employees.

All debris, litter, etc., shall be disposed of in accordance with prevailing ordinance or law. Open burning of trash, debris, etc., will not be permitted.

Such clean-up operations shall be on a daily basis. All pavement, concrete, brush, rocks, excess materials, etc. accumulated or removed during the course of construction must be disposed of in those areas designated by the Engineer or authorized representative, including but not limited to the Lake Havasu City

Landfill. All costs for disposal, including gate or tipping fees, etc. are the responsibility of the Contractor. This material must be disposed of within ten (10) days of time of removal. If the areas in question are not cleaned up to the satisfaction of the Engineer, progress payments will be withheld until clean-up is completed and approved by the Engineer, or, in the case of private projects, other legal action will be taken.

B. TEMPORARY FACILITIES

The Contractor shall provide temporary mailboxes and traffic control signs where necessary until completion of backfilling and clean-up.

C. SOLID WASTES

All solid wastes shall be removed and disposed of in accordance with prevailing ordinance or law. Clean-up shall be completed on a daily basis. All costs for disposal shall be the responsibility of the Contractor, and shall be considered incidental to the costs of the various bid items.

All spilled paving material shall be removed and disposed of prior to final acceptance and payment.

D. MAINTENANCE AREAS

Maintenance areas shall be kept clean during construction and shall be free of litter at all times. All empty containers, debris, waste, etc., shall be removed and disposed of prior to final acceptance. Upon inspection by the Engineer, the Contractor may be required to dress the surface of the ground, dependent upon the extent of spillage of petroleum products on the surface. If so directed, such dressing shall consist of scarifying the surface to a depth of six (6) inches and moving and compacting the soil in such a way as to blend the spill areas into clean soil and restore the surface by partial compaction.

E. POLLUTION

The Contractor shall be held responsible for acts leading to pollution of water, air or land by any means.

Open burning of trash, debris, etc., will not be permitted anywhere in the City limits.

The discharge of any pollutants upon the surface of the ground, or into any stream, ravine, wash or body of water which may result in pollution of the public water supply, or of groundwater contributory thereto, will not be permitted.

Violation of these conditions will be cause for the termination of Work, and possible legal action.

F. REMOVAL AND REPLACEMENT OF SIGNS, MAILBOXES, ETC.

It is the responsibility of the Contractor to remove all poles, etc. which are located within the construction area and replace at the time of backfilling and clean-up in the locations determined by the Street Superintendent. In the case of landscaping or other private items located in the construction area, the Contractor shall hand-deliver a written notice to all residences in that area stating its intentions to perform construction activities and shall do so at least five (5) working days prior to Work commencing. If, at the time of construction these items are still in the construction area, the Contractor is to remove and dispose of them properly. All signs and mailboxes shall be permanently installed within forty-eight (48) hours of completion of construction activities.

G. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)GENERAL PERMIT

At the time of the preconstruction conference, the contractor shall submit, for the Engineer's approval, a program which includes all the measures which the contractor proposes to take for the construction of permanent erosion control work specified in the Contract and all the temporary control measures to prevent erosion and pollution of streams, lakes and reservoirs.

Permanent erosion control work and pollution prevention measures shall be performed at the earliest practicable time consistent with good construction practices. Temporary work and measures are not meant to be performed in lieu of permanent work specified in the Contract.

Construction of drainage facilities as well as the performance of other contract work which will contribute to the control of erosion and sedimentation shall be carried out in conjunction with earthwork operations or as soon thereafter as possible.

Except for that approved in writing by the Engineer, the contractor shall perform no clearing and grubbing or earthwork until the contractor's program has been approved.

If in the opinion of the Engineer, clearing and grubbing, excavation, or other construction operations are likely to create an erosion problem because of the exposure of erodible earth material, the Engineer may limit the surface area to be disturbed until satisfactory control measures have been accomplished. Unless

otherwise permitted by the Engineer, the contractor shall not expose an area of erodible earth material greater than 217,800 square feet at any one location.

The Engineer may order the contractor to provide immediate measures to control erosion and prevent pollution. Such measures may involve the construction of temporary berms, dikes, dams, sediment basins and slope drains; the use of temporary mulches, mats and seeds and the use of other devices, methods, items, etc., as necessary.

At any time the contractor proposes to change its schedule of operations, the contractor shall review and update its erosion and pollution control program and submit it to the Engineer for approval.

The contractor shall not be entitled to additional compensation or an extension of contract time for any delays to the Work because of the contractor's failure to submit an acceptable erosion and pollution control program.

Erosion control and pollution prevention work specified in the Contract which is to be accomplished under any of the various contract items will be paid for by the bid item. Any additional Work required by the Owner will be paid for by the Force Account set up for this Work.

The cost of any erosion control and pollution prevention work which may be proposed by the contractor in its program, in addition to that specified in the Contract, will be considered as included in the prices bid for contract items.

13.0 DUST CONTROL

It shall be the Contractor's responsibility to provide adequate water for dust control. It is imperative that the air quality standards are maintained. In addition, dust could be quite hazardous in the everyday operations. It shall be the Contractor's responsibility to ensure that all regulations for air quality and safety are met.

14.0 SUPERVISORY PERSONNEL

It is the intent of these Special Privisions to provide a completed Project which will in every way reflect the work of competent journeyman mechanics in the various trades represented. The Contractor shall ensure that each portion of the work is supervised by a qualified person, well versed in the operation of the various tools required for the trade, the method in which the work is to be done, and a knowledge of the general requirements of the construction work. All work is to be done in accordance with the latest methods devised for such work to ensure the highest quality product.

15.0 SAFETY REQUIREMENTS

The Contractor shall comply with all pertinent provisions of the Department of Labor "Safety and Health Regulations for Construction" (29 CFR Part 1518, 36 CFR 7340), with additions or modifications thereto, in effect during construction of this Project.

THE FOLLOWING MEASURES OR PROVISIONS ARE TO BE ADHERED TO AT ALL TIMES DURING THE CONSTRUCTION OF THIS PROJECT:

A. All heavy construction machinery to include trenching machines, bulldozers, backhoes, etc., must be equipped with a roll bar meeting the requirements of the above regulation.

B. Safety helmets will be worn by all personnel working at the site. In addition, all spectators and inspectors will be required to wear safety helmets in construction zone.

C. Steel toe safety shoes or boots will be worn by all personnel working at the site.

16.0 PRESERVATION OF BENCH MARKS AND MONUMENTS

The Contractor shall exercise caution to ensure that permanent benchmarks, monuments, established property corners, survey lines, and points are not damaged or disturbed by this Work. If any survey monuments, property corners, survey lines or points are damaged or disturbed, the Contractor's representative shall immediately notify the inspector. All centerline survey monumentation located in pavement removal areas shall be replaced by an Arizona Registered Land Surveyor (R.L.S.) after completion of the pavement removal and replacement operations. All costs incurred to re-establish such points shall be borne by the Contractor.

17.0 DISPOSAL OF EXCESS MATERIAL

Excess soil and unsuitable materials shall be removed from the site by the Contractor at its own expense and disposed of in accordance with the Contract Documents unless otherwise permitted herein. In the event the Contractor chooses to utilize local private lots to dispose of excess material, the Contractor must provide the Engineer with written permission from the lot owner prior to utilizing the lot. Placing material suitable for fill on vacant lots will require a Grading Permit in advance of placing the material.

18.0 REFERENCE STANDARD SPECIFICATIONS

Where standard specifications or testing methods have been referred to, such as ASTM or AASHTO, the intent is to refer to the latest applicable issue or revision of such specifications or testing methods. The following abbreviations are used in these Special Provisions.

AWWA	American Waterworks Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AI	Asphalt Institute
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute (formerly the USA Standards Institute)
ASTM	American Society for Testing and Materials
NSF	National Sanitation Foundation
S.P.W.C.	Standard Specifications for Public Works Construction. (Wherever written herein shall mean "Maricopa Association of Governments, Arizona Specification for Public Works Construction".) The "Sample Forms" and "Part 100 – General Conditions" of these Standard Specifications for Public Works Construction are excluded from the documents for this Project.

19.0 CODES, ORDINANCES AND LOCAL SPECIFICATIONS

All Work under this Project shall be performed in strict accordance with these Special Privisions and the Standard Specifications for Public Works Construction (SPWC). Where any conflict occurs between these plans and specifications and the local codes and ordinances in effect at the time, such codes and ordinances shall take precedence over these plans and specifications only if these plans and specifications are inferior as to materials and workmanship called for by such codes and ordinances.

20.0 INTERFERING STRUCTURES AND UTILITIES

The Contractor shall notify Arizona 811 (formerly Blue Stake) (1-800-782-5348) at least three (3) working days prior to any excavations.

The Contractor shall exercise all possible caution to prevent damage to existing structures and utilities, whether above ground or underground. The Contractor shall notify all utility offices concerned at least seventy-two (72) hours in advance of construction operations in which a utility's facilities may be involved.

Any structure or utility damage caused by the work shall be repaired or replaced in a condition equal to or better than the condition prior to the damage. Such repair or replacement shall be accomplished at the Contractor's expense without additional compensation from the Owner.

If interfering structures or installations such as vaults, manholes, valves, utility poles, guy wires, or anchors are encountered, the Contractor shall notify the Engineer and contact the appropriate utility or structure owner at least seven (7) days in advance of construction to arrange for protection or relocation of the structure.

The Contractor shall remove, protect and/or replace all existing structures, utilities or other improvements and similar items within the proposed improvements at its own expense without additional compensation from the Owner unless specifically provided for as a pay item of Work by the Specifications or as otherwise provided for on the Plans. Replacement shall be in a manner and in a condition at least equivalent to, or better than, the original condition.

If the Contractor encounters existing facilities which will prevent the construction of any facility and which are not properly shown on the Plans, Contractor shall notify the Owner before continuing with the construction in order that the Owner may make such field revisions as necessary to avoid conflict with the existing structure. The cost of waiting or "down" time during such field revision shall be borne by the Contractor without additional cost to the Owner. If the Contractor fails to notify the Owner when an existing structure is encountered, but proceeds with the construction despite this interference, Contractor does so at its own risk. In particular, when the location of the new construction will prohibit the restoration of existing structures to their original condition; the Contractor shall notify the Engineer and contact the utility or structure owner so a field relocation may be made if possible to avoid the conflict.

In the event of interruption to any utility service as a result of accidental breakage or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority. Contractor shall cooperate with the said authority in restoration of service as promptly as possible and shall bear all costs of repair. In no case shall interruption of any utility service be allowed to exist outside working hours unless prior approval of the Owner is received.

Neither the Owner nor its officers or agents shall be responsible for damages to the Contractor as a result of the locations of the water and sewer lines or utilities being other than those shown on the Plans or for the existence of water, sewer lines or utilities not shown on the Plans.

21.0 AIR QUALITY - OPERATING PERMITS

The Contractor may be required to obtain registration certificates and/or operating permits for sources of air pollution.

Information concerning these certificates and permits may be obtained from:

The Office of Air Quality
Arizona Department of Environmental Quality
P.O. Box 600
Phoenix, AZ 85001-0600
(602) 207-2300

22.0 ADJUST UTILITIES TO FINISHED GRADE

The Contractor shall be responsible for locating all manhole rims, valve boxes, meter boxes, utility vaults, etc., and setting them to finished grade. The Contractor shall adjust sewer and water facilities to finished grade in accordance with the specifications within seven (7) days after street surfacing has been completed on each street. All valves and/or manholes will be made visible and accessible for emergency use within 24 hours. It shall be the responsibility of the Contractor to coordinate with the various private utility companies so that they can adjust their facilities to finished grade at an appropriate time. Adjust all facilities in accordance with these specifications and the MAG Standard Details, as modified by Lake Havasu City.

23.0 SAFETY, HEALTH AND SANITATION PROVISIONS

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of its employees as may be necessary to comply with the requirements and regulations of the Arizona State Department of Health.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on its own responsibility or as the Owner may determine, reasonably necessary to protect the life and health of employees on the job, the safety of the public and to protect property in connection with the performance of the Work covered by the Contract.

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal and State occupational safety and health acts, and standards and regulations promulgated thereunder.

24.0 PUBLIC SAFETY AND TRAFFIC CONTROL

Every attempt shall be made to provide public safety during the construction of the

Project. Traffic control shall be performed in accordance with Section 2650, Traffic Control, of the Technical Specifications.

During all construction operations, the Contractor shall construct and maintain such facilities as may be required to provide access for all property owners to their property. No person shall be cut off from access to their residence or place of business for a period exceeding two (2) hours, unless the Contractor has made a special arrangement with the affected persons. It shall be the Contractor's responsibility to notify all adjacent property owners of the construction activity and the schedule of such activities.

The Contractor shall submit for approval a traffic control and barricade plan within ten (10) days of receipt of Notification of Award of Contract. There shall be no deviations from the approved barricade plan unless a revised barricade plan is submitted and approved. The Contractor shall issue a news release once a week for duration of the Project. The release will be published in Sunday's newspaper and shall indicate the area in which the Contractor will be performing work for that week.

Businesses must be notified forty-eight (48) hours prior to any restrictions on normal parking areas used by their employees or patrons.

The Contractor shall contact, cooperate with, and give notice to each resident, homeowner, business or school that will be affected by any part of the construction process, particularly concerning temporary interruptions to vehicular access.

Written notice of the approximate schedule and explanation of work shall be given to each resident, homeowner, business or school at least five (5) days prior to commencement of work in the area. Verbal door-to-door communication shall be made at least twenty-four (24) hours prior to construction to remind all affected parties of the construction to take place.

The Owner shall receive a copy of all notifications to residents. In the event of complaints by residents, the Owner may require the Contractor to provide documentation (i.e., check list) showing the date and time of the verbal door-to-door communication.

In addition, the Contractor is responsible to answer and resolve any conflicts that may arise between a homeowner or business owner and himself during the construction process.

The Contractor shall provide and station competent flaggers whose sole purpose shall be to direct the movement of public traffic through or around the work. Proper advanced warning signs shall be in place when flaggers are working and removed when work requiring flaggers is completed. Flaggers must be used to assist trucks for safe ingress and egress whenever truck movements may interfere with safe passage through the work zone.

All traffic control devices that are not in use or will not be used for a period greater than 72 hours or that are determined by the Engineer to be unnecessary, confusing, or causing an unsafe condition, shall be removed by the Contractor from the public right-of-way immediately upon notification by the Engineer.

Every attempt shall be made to provide public safety during the construction of the Project. Traffic control shall be performed in accordance with Section 2650, Traffic Control, of the Technical Specifications. No person shall be cut off from access to their residence or place of business for a period exceeding six (6) hours, unless the Contractor has made a special arrangement with the affected persons. In addition, no work will be scheduled which will interrupt regular trash pickup to either residential or commercial properties. It will be the Contractor's responsibility to coordinate its activities with the local trash haulers.

No streets, avenues, boulevards or cul-de-sacs will be closed to traffic unless prior arrangements have been made and approval has been obtained from the Engineer.

25.0 TEMPORARY FACILITIES ON SITE

A. General

Except as otherwise provided, the Owner shall bear no costs of temporary facilities and their removal.

B. Temporary Utility Services

The Contractor shall provide temporary electric power as necessary for the execution of the Work, including that required by all Subcontractors. Contractor shall make the necessary arrangements with Owner, shall bear all costs for these temporary services and shall furnish and install all necessary transformers, metering facilities and distribution centers from branch circuits as Contractor may require.

The Contractor shall provide lighting and outlets in temporary structures throughout the Project as may be required for safety, proper performance and inspection of the Work. If operations are performed during hours of darkness, or if natural lighting is deemed insufficient by Owner, the Contractor shall provide adequate floodlights, clusters and spot illumination. The use of permanently installed lighting fixtures, lamps and tubes for work will not be permitted except by special permission of Owner. The Contractor shall make arrangements with Subcontractors for electrical services and lighting as may be necessary in the performance of their work.

Temporary water service lines, if required, shall be installed and removed by the Contractor, who shall pay all charges for making the connections, running the temporary lines, removing the temporary lines at the completion of the Work and disconnecting the services. All relocations required to clear the work of others shall be performed by the Contractor when requested by the Owner.

C. Temporary Structures

Prior to starting Work, the Contractor shall, as directed by Owner, provide and maintain suitable temporary office facilities for the duration of the Project as required for the Contractor's project administration; and all necessary sheds and facilities for the proper storage of tools, materials and equipment employed in the performance of the Work.

D. Toilet Facilities

The Contractor shall provide and maintain temporary toilet facilities for the duration of operations, which shall be maintained in a clean and sanitary condition acceptable to Owner and in full compliance with applicable regulations of any public authority.

E. Telephones

The Contractor shall provide, maintain and pay for telephone services for the duration of the Work as required for the Contractor's operation.

F. Fence and Barricades

The Contractor shall provide such protective fences and barricades as Contractor may deem necessary for public safety and to protect Contractor’s storage areas and the Work in place. The location and appearance of all fences shall be subject to the approval of the Owner.

G. Contractor Parking

The Contractor shall not park its equipment, nor allow its personnel to park, in any area except those specifically designated by the Owner.

H. Temporary Living Quarters

Temporary living quarters shall not be allowed on the job site or on publicly owned properties. In addition, all Lake Havasu City Zoning Codes for the area in question shall be strictly adhered to.

I. Removal of Temporary Construction

The Contractor shall remove temporary office facilities, toilets, storage sheds and other temporary construction from the site as soon as, in Owner's opinion, the progress of Work permits. Contractor shall recondition and restore those portions of the site occupied by the same to a condition equal to or better than it was prior to construction.

26.0 ACCESS TO WASHES

A. Unless otherwise mentioned herein, the Contractor must obtain written permission from the Owner prior to gaining access or utilizing washes or City parcels for any purpose. Request for access to washes and City parcels will be reviewed on a case by case basis. The Contractor shall have access to washes and City parcels via public streets and/or private easements only. For the purposes of this paragraph, "private easement" means a contract by and between the Contractor and a property owner, in writing, authorizing the Contractor to travel across the property owner's real property in order to have ingress or egress to washes, parcels or any portion thereof. Such contracts, if any, shall be filed with the City before the Contractor may exercise the rights thereunder granted. Access to any wash, parcels, or portion thereof by any means not in compliance with the terms of this paragraph shall be deemed a trespass and a breach of the terms of the Contract.

B. Violations of the provisions of subparagraph (A.) hereof, shall entitle the City to deduct the sum of One Thousand Dollars ($1,000.00) from the monies due to Contractor as and for liquidated damages for each such violation. For the purposes of this paragraph, each entry by a vehicle upon land for which Contractor has not received permission to enter shall be deemed a separate violation of subparagraph (A.) hereof.

27.0 COORDINATION AND COOPERATION WITH UTILITY COMPANIES AND OTHER TRADES

A. Coordination/Interruption

The Contractor is responsible to coordinate work with all utility companies and other trades, on or affecting the Project, for an efficient and effective execution of the complete Project. The Contractor shall carefully examine all work that may conflict, and plan removal and/or installation details in advance of the construction to avoid any such conflict. Failure on the Contractor's part to coordinate with any and all utilities, public or private, shall preclude the City's consideration for additional time or cost.

B. Permission Required

Utility mains and utility service to buildings shall not be cut off or otherwise interrupted without the Contractor obtaining permission from the Owner in each and every instance.

C. Scheduling of Interruptions

Where utilities serve facilities or buildings in use, interruptions in service shall be scheduled during the hours when the facility is not in operation. Any overtime costs occasioned thereby shall be regarded as incidental to, and included within, the Contract Price.

D. General Requirements

Prior to interrupting any utility service, the Contractor shall ascertain that it has the proper materials, together with adequate workmen and equipment, to complete the Work with a minimum of delay.

E. Project Electrical Service

The Contractor is responsible to coordinate with Unisource, Electric Division, to determine the extent of work to be performed by Unisource and by the Contractor to provide electric service for the finished product. The Contractor is also responsible to contact Unisource to determine the hardware required by Unisource to provide service to the final product. Unisource does not provide service to delta connections.

****END OF SECTION 00800****

SECTION 01210

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 Description

The outline of measurement and payment in this section is intended to provide a general guideline to the Contractor in preparing bids and submitting pay requests. Listing of work included in each bid item is not intended to include all work, but is to provide general guidance to the Contractor for allocating costs. All work will be paid for on a unit price basis with payment made for the quantity of each item completed.

All materials required for construction shall be furnished by the Contractor unless specifically stated. Items not specifically measured and paid for shall be considered as subsidiary items required to complete the installation in accordance with the intent of the contract documents. The Contractor shall include in the unit price bid items, all costs associated with subsidiary items not being measured for payment.

1.2 Authority

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.

Take all measurements and compute quantities. The Engineer will verify measurements and quantities.

1.3 Unit Quantities

Quantities indicated in the Bid Form are for bidding and contract purpose only. Quantities and measurements supplied or placed in the Work and verified by the Engineer shall determine payment.

If the actual Work requires more or fewer quantities than indicated, provide the required quantities at the unit prices contracted

PART 2 – UNITS AND METHODS OF MEASUREMENT

2.1 General

All items that are included in the bid for measurement and payment are included herein. All other items of work shall be considered subsidiary to construction and will not be measured for payment.

2.2 Units and Methods of Measurement

2.2.1 Mobilization/Demobilization, Bonds and Insurance

The quantity of "Mobilization/Demobilization, Bonds, and Insurance" measured for payment shall be lump sum.

The CONTRACT lump sum bid price for "Mobilization/Demobilization, Bonds, and Insurance" shall be full compensation for furnishing all materials, labor, equipment and tools for all required bonds, insurance, mobilization of staff and equipment, environmental control measures and documentation, and any other costs associated with complying with the contract administrative requirements and commencing WORK at the project site. This item also includes all work and materials necessary to complete the work and to demobilize and perform project closeout as described in the PLANS and SPECIFICATIONS. **Payment for this item shall be lump sum and shall not be requested until at least thirty days from the notice to proceed has elapsed.**

Payment for this item shall be made in accordance with Table A.

TABLE A

Payment for Mobilization on First Partial Payment	Not to exceed 2.5% of the Lump Sum Base Bid
Subsequent payments for Mobilization	Not to exceed 2.5% of the Lump Sum Base Bid
Payment For Mobilization on Final Partial Payment	Any remaining Mobilization in excess of 5% of the Lump Sum Base Bid

2.2.2 SWPP Plan & Implementation

The quantity for "SWPP Plan & Implementation" measured for payment shall be lump sum.

The CONTRACT lump sum bid price for this item shall constitute full compensation for furnishing all materials, labor, equipment and tools for the development and implementation of the Storm Water Pollution Prevention Plan (SWPPP) Plan(s) in accordance with the Specifications and acceptable to the Engineer. All SWPPP's shall be in compliance with the City and Arizona Department of Environmental Quality (ADEQ). This shall include all netting, straw wattles, sandbags, stabilized entrance(s), washout areas, vehicle storage and maintenance areas, and related items necessary to ensure the stormwater quality is maintained throughout the project, at all times. This item also includes all work and materials necessary to complete the work as described in the Plans and Specifications. Payment of this item shall be lump sum.

2.2.3 Contractor Quality Control

The quantity for "Quantity Control" measured for payment shall be lump sum.

The CONTRACT lump sum price for "Quality Control" shall be full compensation for furnishing all materials, labor, equipment, and tools to complete all quality control as described in Special Provision 00800, Section 16.0 and 19.0, as necessary for conformance with the plans.

2.2.4 Construction Staking

The quantity of "Construction Staking" measured for payment shall be lump sum.

The CONTRACT lump sum bid price for this item shall be full compensation for furnishing all materials, labor, equipment and tools to complete all construction layout and staking necessary for conformance with the plans.

2.2.5 General Civil Improvements

Payment for this item shall be on a lump sum basis.

This bid item shall include all necessary activities required for the complete construction of the general site improvements. This item includes clearing and grubbing, earthwork and grading, pavement, and the removal and disposal of existing pavement as required in accordance with the Construction Plans and LHC Specifications.

2.2.6 Demolition of Existing Structures and Chlorine System

Payment for this item shall be on a lump sum basis.

This bid item shall consist of all the labor, materials, tools and equipment required for demolition of the existing structures as shown on the construction plans. Contractor to coordinate with the City regarding what items are to be disposed of and what items are to be salvaged. This item shall include the demolition and disposal or salvaging of onsite items including but not limited to building, piping, equipment, and valves related to the existing chemical system. The salvaged equipment shall be delivered to the City.

2.2.7 Liquid Chlorine Disinfection System

Payment for this item shall be on a lump sum basis.

This bid item shall include all necessary activities required for the complete construction of the liquid chloring disinfection system, including all electrical work, instrumentation, chemical tanks and tank appurtenances, equipment, piping, conduit, valves, materials, building connections, existing system connections, and services required in accordance with the Construction Plans and LHC Specifications.

2.2.8 Chemical Building

Payment for this item shall be on a lump sum basis.

This bid item shall include all necessary activities required for the complete construction of the chemical building, including the building, building slab improvements, structural work, mechanical and HVAC system, plumbing and drain connections, and electrical work in accordance with the Construction Plans and LHC Specifications.

2.2.9 Force Account

Payment for this item shall be on a lump sum basis.

The Contract Lump Sum Price for this item shall be included in the Bid Schedule. Only the OWNER shall determine the use of monies in the "Force Account".

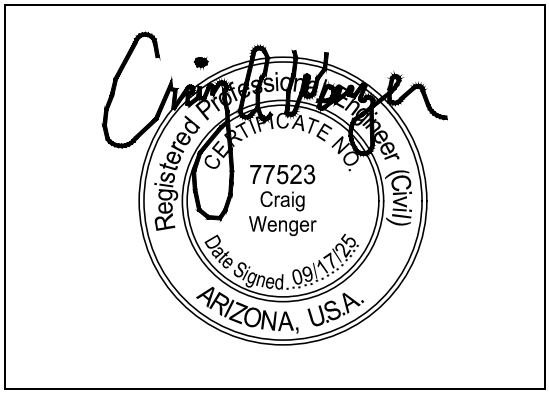
The OWNER will authorize the use of monies in the Force Account by Change Order. Unused Force Account monies will be removed from the Cost of the Work by Change Order.

****END OF SECTION 01210****

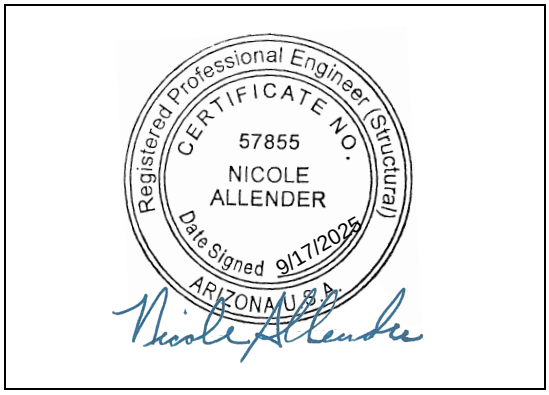
LAKE HAVASU CITY
WATER TREATMENT PLANT IMPROPVEMENT
CITY PROJECT NO. PW-B25-108025-500XXY

The following design professionals certify that the Contract Drawings and Specifications were prepared by them or under their direct supervision.

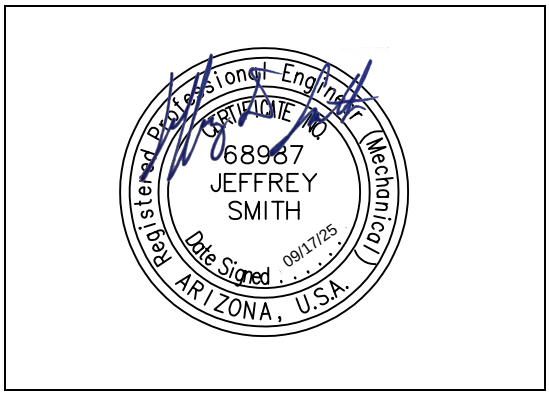
Kimley-Horn and Associates, Inc.
1661 E Camelback Rd Suite #400
Phoenix, AZ 85016



Craig Wenger, PE



Nicole Allender, SE



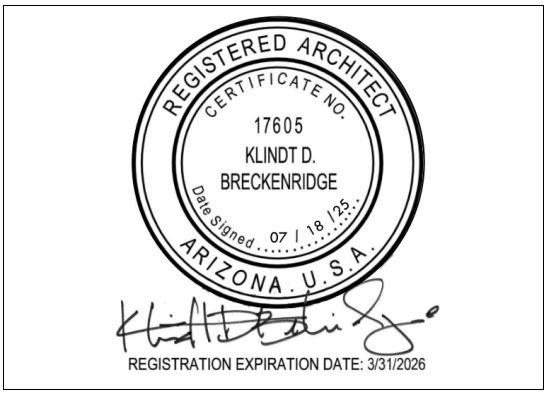
Jeffrey Smith, PE

Erkan Gungor, PE

LAKE HAVASU CITY
WATER TREATMENT PLANT IMPROPVEMENT
CITY PROJECT NO. PW-B25-108025-500XXY

The following design professional certifies that the Contract Drawings and Specifications were prepared by him or under his direct supervision.

Breckenridge Group Architects/Planners
1735 E Fort Lowell Rd. Suite 12
Tucson, AZ 85719
520-882-9944



Klindt Breckenridge, RA

036000 GROUTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Formwork is included in Section 031000.

B. Concrete Reinforcement is included in Section 032000.

C. Cast-in-Place Concrete is included in Section 033000.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 013300, shop drawings and product data showing materials of construction and details of installation for:

1. Commercially manufactured nonshrink cementitious grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature consideration, conformity to required ASTM standards and Material Safety Data Sheet.
2. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.
3. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures and the proposed mix of the grout.

B. Laboratory Test Reports

1. Submit laboratory test data is required under Section 03 00 00 for concrete to be used as concrete grout.

C. Certifications

1. Certify that commercially manufactured grout products and concrete grout admixtures are suitable for use in contact with potable water after 30 days curing.

D. Qualifications

1. Grout manufacturers shall submit documentation that they have at least 10 years of experience in the production and use of the proposed grouts which they will supply.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacings and Polymer Concretes

2. ASTM C579 - Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacings and Polymer Concretes
3. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
4. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. U.S. Army Corps of Engineers Standard (CRD)

1. CRD C-621 - Corps of Engineers Specification for Nonshrink Grout

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturer shall have a minimum of 10 years of experience in the production and use of the type of grout proposed for the work.

B. Pre-installation Conference

1. Well in advance of grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Parties concerned with grouting shall be notified of the meeting at least 10 days prior to its scheduled date.

C. Services of Manufacturer's Representative

1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in the installation of the products, shall attend the pre-installation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided, as required, to correct installation problems.

D. Field Testing

1. All field testing and inspection services required shall be provided by the Owner. The Contractor shall assist in the sampling of materials and shall provide any ladders, platforms, etc., for access to the work. The methods of testing shall comply in detail with the applicable ASTM Standards.
2. The field testing of Concrete Grout shall be as specified for concrete in Section 03300.

1.06 DELIVERY**,** STORAGE AND HANDLING

A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.

B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.

C. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the Owner.

D. Nonshrink cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.

E. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.07 DEFINITIONS

A. Nonshrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.

B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

A. Nonshrink Cementitious Grout

1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be Portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
2. Nonshrink Epoxy Grout
    a. Nonshrink epoxy-based grout shall be a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30 x 10-6 when tested in conformity with ASTM C531.
3. Water
    a. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

PART 3 EXECUTION

3.01 PREPARATION

A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.

B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance, and paints and free of all loose material or foreign matter which may affect the bond or performance of the grout.

C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to a minimum of ¼" amplitude or provide a raked finish to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.
   1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.

D. Remove all loose rust, oil or other deleterious substances from metal embedment or bottom of baseplates prior to the installation of the grout.

E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, flooding the surface, or other method acceptable to the Engineer. Upon completion of the 24 hour period, visible water shall be removed from the surface prior to grouting. The use of an adhesive bonding agent in lieu of surface saturation shall only be used when approved by the Engineer for each specific location of grout installation.

F. Epoxy-based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.

G. Construct grout forms or other leakproof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate strength, securely anchored in place and shored to resist the forces imposed by the grout and its placement.

H. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.

I. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.

J. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the Engineer.

3.02 INSTALLATION – GENERAL

A. Mix, apply, and cure products in strict compliance with the manufacturer's recommendations and this Section.

B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.

C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours thereafter or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.

D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 and 90 degrees F range.

E. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.

F. Reflect all existing underlying expansion, control and construction joints through the grout.

3.03 INSTALLATION –NONSHRINK CEMENTITIOUS GROUTS

A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Engineer.

B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.

C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.

D. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.

F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of bearing plate unless otherwise approved by the Engineer. Finish this surface with a wood float (brush) finish.

G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding, or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.04 INSTALLATION - NONSHRINK EPOXY GROUTS

A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Mix full batches only to maintain proper proportions of resin, hardener and aggregate.

B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.

C. Place grout into the designated areas in a manner which will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

D. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.

E. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.

F. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

3.05 SCHEDULE

A. The following list indicates where the particular types of grout are to be used:

B. General purpose nonshrink cementitious grout: Use at all locations where non shrink grout is called for on the plans except for base plates greater in area than 3-ft wide by 3-ft long and except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.

C. Flowable nonshrink cementitious grout: Use under all base plates greater in area than 3-ft by 3-ft. Use at all locations indicated to receive flowable nonshrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable nonshrink grout for general purpose nonshrink cementitious grout.

D. Nonshrink epoxy grout: Use for the setting of anchor rods, anchor bolts and reinforcing steel in concrete and for all locations specifically indicated to receive epoxy grout.

END OF SECTION

04 22 00 Concrete Unit Masonry

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Steel reinforcing bars.
3. Mortar and grout materials.

1.02 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
2. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

A. Samples: For each type and color of the following:

4. Exposed CMUs.
5. Pigmented and colored-aggregate mortar.

1.04 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For each type and size of product. For masonry units, include data on material properties.
2. Integral water repellent used in CMUs, if not surface treated.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109 for compressive strength, ASTM C1506 for water retention, and ASTM C91 for air content.

2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 402/602.

1.05 QUALITY ASSURANCE

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for typical exterior and interior walls in sizes approximately 48 inches long by 48 inches high by full thickness. Sample panel to include flashings, weeps, insulation, control joint sealant and sealer. Panel not to be removed until masonry work has been accepted by the Architect. Use sample panel to test cleaning methods.

1.06 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.01 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Knockout blocks will not be acceptable.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

C. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Medium weight unless otherwise indicated.
3. Size, Nominal (8”x8”x16” or as indicated on drawings): Manufactured to dimensions 3/8” less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.03 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91.

E. Mortar Cement: ASTM C1329.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979. Use only pigments with a record of satisfactory performance in masonry mortar.

G. Aggregate for Mortar: ASTM C144.

1. White-Mortar Aggregates: Natural white sand or crushed white stone.

2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C404.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
2. Water: Potable.

2.04 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615 or ASTM A996, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A951.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.05 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82, with ASTM A153, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008, Commercial Steel, with ASTM A153, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A36.

2.06 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240 or ASTM A666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
4. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
5. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.07 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226, Type I (No. 15 asphalt felt).

2.08 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270 Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.
4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:
    a. Decorative CMUs.
    b. Pre-faced CMUs.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
    a. Decorative CMUs.
    b. Pre-faced CMUs.

F. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.02 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.03 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.04 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.05 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.06 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

G. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.07 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.08 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.09 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level 3 in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

I. Prism Test: For each type of construction provided, according to ASTM C1314 at seven days and at 28 days.

3.10 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.11 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.12 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
2. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
3. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. LH-series long-span steel joists.
2. Joist girders.
3. Joist accessories.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.03 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Manufacturer certificates.

C. Mill Certificates: For each type of bolt.

D. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.01 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.

2.02 JOIST GIRDERS

A. Manufacture joist girders according to "Standard Specification for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated.

2.03 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.04 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

C. Bridging: Fabricate as indicated and according to SJI's "Specifications". Furnish additional erection bridging if required for stability.

D. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

E. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

1. Finish: Plain

F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.05 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories.

B. Apply one coat of shop primer to joists and joist accessories.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.02 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION

053100 Steel Decking

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Roof deck.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.03 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Evaluation reports.

D. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.02 ROOF DECK

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), G60 zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.

2.03 ACCESSORIES

C. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

D. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

E. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

F. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

G. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000psi , not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

C. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

D. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

E. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

F. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

G. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

H. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

I. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

J. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.02 FIELD QUALITY CONTROL

K. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

L. Field welds will be subject to inspection.

M. Prepare test and inspection reports.

3.03 PROTECTION

N. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

O. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation and apply paint.

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items as indicated in the drawings.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.

C. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

1.03 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.

1.04 QUALITY ASSURANCE

A. Design exterior door canopies under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Plates: ASTM A283/A283M.

C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 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. 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.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FINISHES - STEEL

A. Prime paint steel items.

B. Prime Painting: One coat.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

SECTION 055133
METAL LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prefabricated ladders.

1.02 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders; Current Edition.

B. 29 CFR 1926.1053 - Ladders; Current Edition.

C. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

D. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

E. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.

F. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.

G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

H. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.

I. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.

J. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

1.03 SUBMITTALS

A. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

B. Specimen warranty.

C. Executed warranty.

1.04 QUALITY ASSURANCE

A. Design ladders under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

1.05 WARRANTY

A. Manufacturer Warranty: Provide 5-year manufacturer warranty for material and workmanship. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B211/B211M, 6063 alloy, T6 temper.

B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6061 alloy, T6 temper.

D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.

E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.

F. Aluminum-Alloy Die Castings: ASTM B85/B85M .

G. Bolts, Nuts, and Washers: Stainless steel.

H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.02 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. 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.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 PREFABRICATED LADDERS

A. Basis of Design: Kattsafe Model RL 42: Caged fixed ladder with parapet platform and roof-side open ladder. Substitions that meet the required performance and quality of fabrication and installation shall be allowed.
   1. Ladder Fall Arrest System: Model RL50SYS or as recommended by the selected manufacturer for compliance with the selected ladder model.
   2. Ladder Security Door: Model LD426 or as recommended by the selected manufacturer for compliance with the selected ladder model.
   3. Ladder Cage Gate: Model LD425 or as recommende by the selected manufacturer for compliance with the selected ladder model.

B. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
   1. Components: Manufacturer's standard rails, rungs, treads, handrails. returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
   2. Materials: Aluminum; 6063 alloy, T52 temper.
   3. Finish: Clear anodize.
   4. Manufacturers:
      a. Substitutions: As permitted by Owner with prior approval of Architect/Engineer.

2.04 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Class I natural anodized.

B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

2.05 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

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work. Confirm ladder dimension on roof-side from top of parapet to roof level prior to fabrication.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 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. Obtain approval prior to site cutting or making adjustments not scheduled.

D. After erection, prime welds, abrasions .

3.04 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 055213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stair railings and guardrails.

1.02 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

B. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.

C. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.

D. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.

E. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications; 2021.

F. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2024.

1.03 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.04 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Comply with ASTM E985.

C. Allow for expansion and contraction of members and building movement without damage to connections or members.

D. Dimensions: See drawings for configurations and heights.
   1. Top Rails and Wall Rails: 1-1/2 inches (38 mm) diameter, round.
   2. Intermediate Rails: 1-1/2 inches (38 mm) diameter, round.
   3. Posts: 1-1/2 inches (38 mm) diameter, round.

E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
   2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.

F. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 ALUMINUM MATERIALS

A. Aluminum Pipe: Schedule 40; ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.

B. Solid Bars and Flats: ASTM B211/B211M.

C. Non-Weld Mechanical Fittings: Slip-on cast aluminum, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

D. Welding Fittings: No exposed fasteners; cast aluminum.

E. Straight Splice Connectors: Concealed spigot; cast aluminum.

F. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   2. 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.

2.04 ALUMINUM FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, 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 061053
MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof-mounted curbs.

B. Roofing nailers.

C. Roofing cant strips.

D. Preservative treated wood materials.

E. Concealed wood blocking, nailers, and supports.

1.02 REFERENCE STANDARDS

A. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.

B. PS 20 - American Softwood Lumber Standard; 2025.

1.03 SUBMITTALS

A. Product Data: Provide technical data on wood preservative materials and application instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch, unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No.2 or Standard Grade.
   2. Boards: Standard or No.3.

D. Parapet Caps: 1-1/2 inch (38 mm) thick, laminated strand lumber.
   1. Comply with AWPA U1 use category 2.

2.03 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. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

2.04 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.

PART 3 EXECUTION

3.01 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.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

3.03 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

END OF SECTION

06 74 13 Fiberglass Reinforced Gratings

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes glass-fiber-reinforced-plastic gratings.

1.02 ACTION SUBMITTALS

A. Product Data: For glass-fiber-reinforced-plastic gratings.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Floors: Uniform load of 250lbf/sq. ft or concentrated load of 16,000lbf, whichever produces the greater stress

2. Limit deflection to 1/4 inch.

2.02 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

2.03 FABRICATION

A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form gratings from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.04 GRATING FRAMES AND SUPPORTS

A. Frames and Supports for Glass-Fiber-Reinforced-Plastic Gratings: Fabricate from glass-fiber-reinforced-plastic shapes of sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

B. Equip units indicated to be cast into concrete with integral anchors.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation: measured from established lines and levels and free of rack.

B. Fit exposed connections accurately together to form hairline joints.

3.02 INSTALLING GLASS-FIBER-REINFORCED-PLASTIC GRATINGS

A. Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for bolted connections.

END OF SECTION

SECTION 068316
FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

B. Trim.

1.02 REFERENCE STANDARDS

A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Samples: Submit two samples 6"by 6" inch (____x____ mm) in size illustrating material and surface design of panels.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Panels: Quantity equal to 5 percent of total installed.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
   1. Marlite, Inc: www.marlite.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels:
   1. Panel Size: 4 by 8 feet (1.2 by 2.4 m).
   2. Panel Thickness: 0.10 inch (2.5 mm).
   3. Surface Design: Smooth.
   4. Color: As selected by Architect.
   5. Attachment Method: Mechanical fasteners concealed by trim, with sealant in joints.

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.

B. Trim: Vinyl; color coordinating with panel.

C. Fasteners: Nylon rivets.

D. Adhesive: Type recommended by panel manufacturer.

E. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

C. Verify that layout of hangers will not interfere with other work; make adjustments in layout as necessary.

3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Pre-drill fastener holes in panels, 1/8 inch (3.2 mm) greater in diameter than fastener, spaced as indicated by panel manufacturer.

D. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

E. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

F. Install panels with manufacturer's recommended gap for panel field and corner joints.

G. Drive fasteners to provide snug fit, and do not over-tighten.

H. Place trim on panel before fastening edges, as required.

I. Fill channels in trim with sealant before attaching to panel.

J. Install trim with adhesive and screws or nails, as required.

K. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

L. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 072400
EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Composite wall cladding of rigid insulation and reinforced finish coating, Class PB.

B. Drainage and water-resistive barriers behind insulation board.

C. Incidental uses of same finish coating applied directly to concrete and masonry.

1.02 REFERENCE STANDARDS

A. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2023.

B. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).

C. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2013 (Reapproved 2019).

D. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2022.

E. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

F. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

G. ASTM E695 - Standard Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading; 2022.

H. ASTM E1677 - Standard Specification for Air Barrier (AB) Material or Assemblies for Low-Rise Framed Building Walls; 2023.

I. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2018.

J. NFPA 259 - Standard Test Method for Potential Heat of Building Materials; 2023, with Errata.

K. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.

L. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.03 SUBMITTALS

A. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.

B. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures.

C. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

D. Installer's qualification statement.

1.04 QUALITY ASSURANCE

A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.

B. Installer Qualifications: Company specializing in the type of work specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.

B. Storage: Store materials as directed by manufacturer's written instructions.
   1. Protect insulation materials from exposure to sunlight.

1.06 FIELD CONDITIONS

A. Do not prepare materials or apply EIFS under conditions other than those described in the manufacturer's written instructions.

B. Do not prepare materials or apply EIFS during inclement weather unless areas of installation are protected. Protect installed EIFS areas from inclement weather until dry.

C. Do not leave installed insulation board exposed to sunlight for extended periods of time.

1.07 WARRANTY

A. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

B. Provide separate warranty from installer covering labor for repairs or replacement for a period of not less than 5 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design:
   1. Dryvit Systems, Inc; Dryvit Outsulation Plus MD EIFS, Class PB with Moisture Drainage: www.dryvit.com/#sle.

B. Other Acceptable Exterior Insulation and Finish Systems Manufacturers:
   1. Substitutions: as reviewed by Architect and approved by Owner.

2.02 EXTERIOR INSULATION AND FINISH SYSTEM

A. Exterior Insulation and Finish System: DRAINAGE type; reinforced finish coating on mechanically-fastened insulation board over sheet-type combination drainage layer/water-resistive barrier over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.

B. Fire Characteristics:
   1. Flammability: Pass, when tested in accordance with NFPA 285.
   2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
   3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot (mJ/sq m).

C. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf (299 Pa) differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.

D. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.

E. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.

F. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.

G. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons (500 liters) of sand.

H. Impact Resistance: No cracking or denting when tested in accordance with ASTM E695 with a 30 pound (14 kg) impact mass.

2.03 MATERIALS

A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
   1. Texture: Medium.

B. Combination Drainage Layer/Water-Resistive Barrier: Air- and water-resistive sheet complying with ASTM E1677 Type I, dimpled or otherwise profiled to maintain air and drainage space between insulation board and sheathing; minimum water vapor permeance of 20 perms (1149 ng/Pa s sq m); furnished or approved by EIFS manufacturer.

2.04 ACCESSORIES

A. Insulation Adhesive: Type required by EIFS manufacturer for project substrate.

B. Insulation Fasteners: Fastener and plate system appropriate for substrate and as recommended by EIFS manufacturer.

C. Trim: EIFS manufacturer's standard PVC or galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.

D. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

B. Verify that substrate surface is flat, with no deviation greater than 1/4 in (6 mm) when tested with a 10 ft (3 m) straightedge.

3.02 PREPARATION

A. Install self-furring metal lath over solid substrates that are deemed unacceptable to receive adhesively applied insulation. Install in accordance with ASTM C1063, except for butt-lapping instead of overlapping.
   1. Attach to concrete masonry using corrosion-resistant power or powder actuated fasteners not less than 3/4 inch (19 mm) long and with heads not less than 3/8 inch (9.5 mm) wide. Ensure that fasteners are securely attached to substrate and spaced at maximum 16 inches (406 mm) on center horizontally and 7 inches (178 mm) vertically.

B. Apply primer to substrate as recommended by EIFS manufacturer for project conditions.

3.03 INSTALLATION - GENERAL

A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.

3.04 INSTALLATION - WATER-RESISTIVE BARRIER

A. Apply barrier coating as recommended by coating manufacturer; prime substrate as required before application.

B. Seal substrate transitions and intersections with other materials to form continuous water-resistive barrier on exterior of sheathing, using method recommended by manufacturer.

C. At door and window rough openings and other wall penetrations, seal water-resistive barrier and flexible flashings to rough opening before installation of metal flashings, sills, or frames, using method recommended by manufacturer.

D. Lap flexible flashing or flashing tape at least 2 inches (50 mm) on each side of joint or transition.

3.05 INSTALLATION - INSULATION

A. Install in accordance with manufacturer's instructions.

B. Prior to installation of boards, install starter track and other trim level and plumb and securely fastened. Install only in full lengths, to minimize moisture intrusion; cut horizontal trim tight to vertical trim.

C. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.

D. On wall surfaces, install boards horizontally.

E. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch (1.6 mm).

F. Fill gaps greater than 1/16 inch (1.6 mm) with strips or shims cut from the same insulation material.

G. Rasp irregularities off surface of installed insulation board.

H. Mechanical Fastening: Space fasteners as recommended by EIFS manufacturer.

END OF SECTION

SECTION 075216
075216 SBS MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.

C. ASTM D312/D312M - Standard Specification for Asphalt Used in Roofing; 2016a (Reapproved 2023).

D. ASTM D6162/D6162M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements; 2021.

E. ASTM D6163/D6163M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements; 2021.

F. ASTM D6164/D6164M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements; 2021.

G. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies; Current Edition, Including All Revisions.

H. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

I. UL 1897 - Uplift Tests for Roof-Covering Systems; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.02 SECTION INCLUDES:

A. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.

B. Roof insulation.

C. Cover board.

1.03 PREINSTALLATION MEETING

2.01 PREINSTALLATION ROOFING CONFERENCE: CONDUCT CONFERENCE AT PROJECT SITE.

A. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

B. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

C. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

D. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

E. Review structural loading limitations of roof deck during and after roofing.

F. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.

G. Review governing regulations and requirements for insurance and certificates if applicable.

H. Review temporary protection requirements for roofing system during and after installation.

I. Review roof observation and repair procedures after roofing installation.

3.01 PRODUCT DATA: FOR EACH TYPE OF PRODUCT.

3.02 SHOP DRAWINGS: INCLUDE PLANS, SECTIONS, DETAILS, AND ATTACHMENTS TO OTHER WORK, INCLUDING THE FOLLOWING:

A. Layout and thickness of insulation.

B. Base flashings and membrane terminations.

C. Flashing details at penetrations.

D. Tapered insulation, including slopes.

E. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.

F. Crickets, saddles, and tapered edge strips, including slopes.

G. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

3.03 WIND UPLIFT RESISTANCE SUBMITTAL: FOR ROOFING SYSTEM INDICATING COMPLIANCE WITH WIND UPLIFT PERFORMANCE REQUIREMENTS.

INFORMATIONAL SUBMITTALS

4.01 MANUFACTURER CERTIFICATES:

A. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of complying with performance requirements.

B. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

4.02 PRODUCT TEST REPORTS: FOR ROOF MEMBRANE AND INSULATION, TESTS PERFORMED BY A QUALIFIED TESTING AGENCY, INDICATING COMPLIANCE WITH SPECIFIED REQUIREMENTS.

A. Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147. Membranes must meet or exceed all performance characteristics including tensile strengths, tear strengths, elongation and recycled content. Testing must be performed at 73.4 deg. F +/- 3.6 deg. F.

4.03 RESEARCH/EVALUATION REPORTS: FOR COMPONENTS OF ROOFING SYSTEM, FROM ICC-ES.

4.04 SAMPLE WARRANTIES: FOR MANUFACTURER’S SPECIAL 20-YEAR NON-PRORATED NO DOLLAR LIMIT WARRANTY AND INSTALLER’S SAMPLE TWO-YEAR WARRANTY.

CLOSEOUT SUBMITTALS

5.01 MAINTENANCE DATA.

QUALITY ASSURANCE

6.01 INSTALLER QUALIFICATIONS: A QUALIFIED FIRM THAT IS APPROVED, AUTHORIZED, OR LICENSED BY ROOFING SYSTEM MANUFACTURER TO INSTALL MANUFACTURER'S PRODUCT AND THAT IS ELIGIBLE TO RECEIVE MANUFACTURER'S SPECIAL WARRANTY.

PRODUCT INFORMATION REQUIRED WITH BID SUBMITTAL AND DUE AT BID OPENING

7.01 REQUIRED PRODUCT INFORMATION TO BE SUBMITTED WITH BID:

A. Product Identification: Include manufacturer's current literature and manufacturer's name and address.

B. Test Reports: Provide independent test data for all modified surfacing sheets. Certification must be from an accredited independent testing laboratory comparing the physical and performance characteristics of the proposed material with those of the specified materials. Test results must be dated, notarized, and on testing laboratory stationary.

C. Manufacturer's Fire Compliance Certificate: Certify that the roofing system furnished is approved by Factory Mutual (FM), Underwriters Laboratories (UL), Warnock Hersey (WH), or approved third party testing facility in accordance with ASTM E108, Class A for external fire and meets local or nationally recognized building codes.

D. List of at least five projects, where the proposed material was used under similar climate conditions. These projects must be available for inspection by the Architect.

E. Statement from the roofing system manufacturer stating that all Bid Documents have been reviewed and approved, the site conditions are acceptable for the roofing assembly being installed, and the roofing system manufacturer will provide field inspections during construction which shall occur as appropriate to the complexity and progress of the work, but no less than once per week, and until all construction work is completed and accepted by the Owner and Architect. Inspections shall be performed by a full-time employee of the manufacturer. Manufacturer’s representative shall send to Architect electronically a written summary of details of inspection with photo documentation.

7.02 PRODUCTS WILL NOT BE CONSIDERED IF:

A. Product or method of major waterproofing field components to be considered does not have a minimum of five years of successful performance in roofing and reroofing applications in the United States.

B. Independent test data from an independent testing agency is not provided with the Bid Documents.

C. The independent test data does not meet or exceed the minimum performance standards specified.

D. Acceptance will require substantial revision of Contract Documents.

E. Architect/Owner reserves the right to be the final authority on the acceptance or rejection of any and all products.

MANUFACTURER’S INSPECTIONS

8.01 WHILE THE PROJECT IS IN PROGRESS, THE ROOFING SYSTEM MANUFACTURER WILL PROVIDE THE FOLLOWING:

A. Report progress and quality of the work as observed.

B. Provide periodic job site inspections no less than once per week followed by emailed photo reports documenting the inspection on those days.

C. Report to the Owner and Architect in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor’s attention.

D. Confirm after completion that manufacturer has observed no applications procedures in conflict with the specifications other than those that may have been previously reported and corrected.

DELIVERY, STORAGE, AND HANDLING

9.01 DELIVER ROOFING MATERIALS TO PROJECT SITE IN ORIGINAL CONTAINERS WITH SEALS UNBROKEN AND LABELED WITH MANUFACTURER'S NAME, PRODUCT BRAND NAME AND TYPE, DATE OF MANUFACTURE, APPROVAL OR LISTING AGENCY MARKINGS, AND DIRECTIONS FOR STORING AND MIXING WITH OTHER COMPONENTS.

9.02 STORE LIQUID MATERIALS IN THEIR ORIGINAL UNDAMAGED CONTAINERS IN A CLEAN, DRY, PROTECTED LOCATION AND WITHIN THE TEMPERATURE RANGE REQUIRED BY ROOFING SYSTEM MANUFACTURER. PROTECT STORED LIQUID MATERIAL FROM DIRECT SUNLIGHT.

9.03 DISCARD AND LEGALLY DISPOSE OF LIQUID MATERIAL THAT CANNOT BE APPLIED WITHIN ITS STATED SHELF LIFE.

9.04 PROTECT ROOF INSULATION MATERIALS FROM PHYSICAL DAMAGE AND FROM DETERIORATION BY SUNLIGHT, MOISTURE, SOILING, AND OTHER SOURCES. STORE IN A DRY LOCATION. COMPLY WITH INSULATION MANUFACTURER'S WRITTEN INSTRUCTIONS FOR HANDLING, STORING, AND PROTECTING DURING INSTALLATION.

9.05 HANDLE AND STORE ROOFING MATERIALS, AND PLACE EQUIPMENT IN A MANNER TO AVOID PERMANENT DEFLECTION OF DECK.

FIELD CONDITIONS

10.01 WEATHER LIMITATIONS: PROCEED WITH INSTALLATION ONLY WHEN EXISTING AND FORECASTED WEATHER CONDITIONS PERMIT ROOFING SYSTEM TO BE INSTALLED ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS AND WARRANTY REQUIREMENTS.

10.02 DO NOT APPLY ROOFING MATERIALS OR MEMBRANE TO DAMP DECK SURFACE.

10.03 DO NOT EXPOSE MATERIALS VULNERABLE TO WATER OR SUN DAMAGE IN QUANTITIES GREATER THAN CAN BE WEATHERPROOFED DURING SAME DAY.

WARRANTY

11.01 SPECIAL WARRANTY: MANUFACTURER AGREES TO REPAIR OR REPLACE COMPONENTS OF ROOFING SYSTEM THAT FAIL IN MATERIALS OR WORKMANSHIP WITHIN SPECIFIED WARRANTY PERIOD. FAILURE INCLUDES ROOF LEAKS.

A. Special warranty without monetary limit (non-prorated no dollar limit) that includes roofing membrane, base flashings, fasteners, cover boards, substrate boards, roofing accessories, and other components of roofing system. Failure includes roof leaks, blisters, ponding, sliding materials, loss of granules, etc.

B. Warranty Period: 20 years minimum from date of Substantial Completion.

11.02 SPECIAL PROJECT WARRANTY: SUBMIT ROOFING INSTALLER'S WARRANTY, ON WARRANTY FORM AT END OF THIS SECTION, SIGNED BY INSTALLER, COVERING WORK OF THIS SECTION, INCLUDING ALL COMPONENTS OF ROOFING SYSTEM SUCH AS ROOFING MEMBRANE, BASE FLASHING, FASTENERS, COVER BOARDS, AND SUBSTRATE BOARDS, FOR THE FOLLOWING WARRANTY PERIOD:

A. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

12.01 PERFORMANCE REQUIREMENTS

12.02 ACCELERATED WEATHERING: ROOF MEMBRANE SHALL WITHSTAND 2000 HOURS OF EXPOSURE WHEN TESTED ACCORDING TO ASTM G152, ASTM G154, OR ASTM G155.

12.03 IMPACT RESISTANCE: ROOF MEMBRANE SHALL RESIST IMPACT DAMAGE WHEN TESTED ACCORDING TO ASTM D3746/D3746M, ASTM D4272/D4272M, OR THE "RESISTANCE TO FOOT TRAFFIC TEST" IN FM APPROVALS 4470.

12.04 WIND UPLIFT RESISTANCE: DESIGN ROOFING SYSTEM TO RESIST THE FOLLOWING WIND UPLIFT PRESSURES WHEN TESTED ACCORDING TO FM APPROVALS 4474, UL 580, OR UL 1897:

A. Zone 1 (Roof Area Field): 20 lbf/sq. ft.

B. Zone 2 (Roof Area Perimeter): 33.6 lbf/sq. ft.
   1. Location: From roof edge to 8 feet (243.84 cm) 0 inch (0 mm). inside roof edge.

C. Zone 3 (Roof Area Corners): 33.6 lbf/sq. ft.
   1. Location: 8 feet (243.84 cm) 0 inch (0 mm). in each direction from each building corner.

12.05 FM APPROVALS' ROOFNAV LISTING: ROOF MEMBRANE, BASE FLASHINGS, AND COMPONENT MATERIALS SHALL COMPLY WITH REQUIREMENTS IN FM APPROVALS 4450 OR FM APPROVALS 4470 AS PART OF A ROOFING SYSTEM, AND SHALL BE LISTED IN FM APPROVALS' ROOFNAV FOR CLASS 1 OR NONCOMBUSTIBLE CONSTRUCTION, AS APPLICABLE. IDENTIFY MATERIALS WITH FM APPROVALS CERTIFICATION MARKINGS.

A. Fire/Windstorm Classification: Class 1A-90.

12.06 ENERGY STAR LISTING: ROOFING SYSTEM SHALL BE LISTED ON THE DOE'S ENERGY STAR "ROOF PRODUCTS QUALIFIED PRODUCT LIST" FOR LOW-SLOPE ROOF PRODUCTS.

12.07 EXTERIOR FIRE-TEST EXPOSURE: ASTM E108 OR UL 790, CLASS A; FOR APPLICATION AND ROOF SLOPES INDICATED; TESTING BY A QUALIFIED TESTING AGENCY.

A. Identify products with appropriate markings of applicable testing agency.

12.08 IN A MULTI-PLY BUR ASSEMBLY, NOT TO EXCEED THREE LAYERS, THE SUM/COMPOSITE OF ALL LAYERS MUST MEET OR EXCEED 850 LBF OF TEAR STRENGTH AND 500 LBF/IN OF TENSILE STRENGTH IN BOTH MACHINE DIRECTION (MD) AND CROSS MACHINE DIRECTION (XD) WHEN TESTED PER ASTM D5147 AT 73.4 +/- 3.6 DEG. F.

MANUFACTURERS

13.01 IT IS THE INTENT OF THIS SPECIFICATION TO SET STANDARDS BASED PERFORMANCE. PERFORMANCE CRITERIA WERE BASED ON PRODUCT PERFORMANCE, SPECIFICATION REQUIREMENTS, FINANCIAL STABILITY TO STAND BEHIND A PROVIDED WARRANTY, SYSTEM COMPATIBILITY, AND SINGLE SOURCE RESPONSIBILITY, SERVICE AND DESIGN CRITERIA.

13.02 SOURCE LIMITATIONS: OBTAIN COMPONENTS INCLUDING ROOF INSULATION, FASTENERS, COATINGS, MASTICS, SEALANTS, AND ROOF ACCESSORIES FOR ROOFING SYSTEM FROM ROOF MEMBRANE MANUFACTURER OR MANUFACTURER APPROVED BY ROOF MEMBRANE MANUFACTURER.

BASE SHEET MATERIALS

14.01 SBS-MODIFIED BITUMEN POLYESTER AND FIBERGLASS MAT BASE SHEET: ASTM D6162/D6162M, ASTM D6163/D6163M, OR ASTM D6164/D6164M, TYPE III, GRADE S, SBS-MODIFIED ASPHALT SHEET, REINFORCED WITH A COMBINATION OF POLYESTER AND/OR FIBERGLASS FABRIC, SMOOTH SURFACED, SUITABLE FOR HOT ASPHALT METHOD.

A. Tensile Strength, ASTM D5147:
   1. MD 340 lbf./in. XD 340 lbf./in., 2 inch (50.8 mm)/min @ 73.4 +/- 3.6 deg. F.

B. Tear Strength, ASTM D5147:
   1. MD 500 lbf. XD 500 lbf., 2 inch (50.8 mm)./min. @ 73.4 +/- 3.6 deg. F.

STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS CAP SHEET

15.01 SMOOTH-SURFACED ROOFING CAP SHEET: ASTM ASTM D6162/D6162M, ASTM D6163/D6163M, OR ASTM D6164/D6164M, TYPE III, GRADE S, SBS-MODIFIED ASPHALT SHEET, REINFORCED WITH A COMBINATION OF POLYESTER AND/OR FIBERGLASS FABRIC, SUITABLE FOR HOT ASPHALT APPLICATION METHOD.

A. Tensile Strength, ASTM D5147:
   1. MD 340 lbf./in. XD 340 lbf./in., 2 inch (50.8 mm)./min. @ 73.4 +/- 3.6 deg. F.

B. Tear Strength, ASTM D5147:
   1. MD 500 lbf. XD 500 lbf., 2 inch (50.8 mm)./min. @ 73.4 +/- 3.6 deg. F.

BASE FLASHING SHEET MATERIALS

16.01 BACKER SHEET: ASTM D6162/D6162M, ASTM D6163/D6163M, OR ASTM D6164/D6164M, TYPE III, GRADE S, SBS-MODIFIED ASPHALT SHEET, REINFORCED WITH A COMBINATION OF POLYESTER AND/OR FIBERGLASS FABRIC, SMOOTH SURFACED; SUITABLE FOR APPLICATION METHOD SPECIFIED.

A. Tensile Strength, ASTM D5147:
   1. MD 340 lbf./in. XD 340 lbf./in., 2 inch (50.8 mm)./min. @ 73.4 +/- 3.6 deg. F.

B. Tear Strength, ASTM D5147:
   1. MD 500 lbf. XD 500 lbf., 2 inch (50.8 mm)./min. @ 73.4 +/- 3.6 deg. F.

16.02 FLASHING CAP SHEET: ASTM D6754/D6754M, HIGH-PERFORMANCE FABRIC REINFORCED THERMOPLASTIC MEMBRANE; SUITABLE FOR APPLICATION METHOD SPECIFIED AND APPROVED BY ROOFING MEMBRANE MANUFACTURER.

A. Thickness: 60 mils (1.524 mm).

B. Exposed Face Color: White.

16.03 LIQUID FLASHING SYSTEM: ROOF MEMBRANE MANUFACTURER'S STANDARD ONE- OR TWO-PART MOISTURE CURING RESIN WITH LOW SOLVENT CONTENT, CONSISTING OF A PRIMER, FLASHING CEMENT, AND SCRIM.

AUXILIARY ROOFING MATERIALS

17.01 GENERAL: AUXILIARY MATERIALS RECOMMENDED BY ROOFING MANUFACTURER FOR INTENDED USE AND COMPATIBLE WITH ROOFING.

A. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

17.02 METAL TERMINATION BARS: MANUFACTURER'S STANDARD, PREDRILLED STAINLESS-STEEL OR ALUMINUM BARS, APPROXIMATELY 1 BY 1/8 INCH (3.18 MM) THICK; WITH ANCHORS.

17.03 FLASHING CAP SHEET ADHESIVE: ROOFING MANUFACTURER'S RECOMMENDED ADHESIVE SPECIALLY FORMULATED FOR COMPATIBILITY AND USE WITH BASE FLASHINGS.

17.04 MASTIC SEALANT: WHITE, POLYETHER, TROWEL GRADE, FLASHING MASTIC FOR COLD-APPLIED APPLICATIONS.

17.05 FASTENERS: FACTORY-COATED STEEL FASTENERS AND METAL OR PLASTIC PLATES COMPLYING WITH CORROSION-RESISTANCE PROVISIONS IN FM APPROVALS 4470, DESIGNED FOR FASTENING ROOFING COMPONENTS TO SUBSTRATE; TESTED BY MANUFACTURER FOR REQUIRED PULLOUT STRENGTH, AND ACCEPTABLE TO ROOFING SYSTEM MANUFACTURER.

17.06 FLOOD COAT: HIGHLY REFLECTIVE, ALIPHATIC POLYUREA LIQUID-APPLIED WATERPROOFING MEMBRANE DESIGNED TO MAINTAIN, RESTORE AND UPGRADE THE PERFORMANCE OF EXISTING MEMBRANES; SUITABLE FOR APPLICATION METHOD SPECIFIED. FOR USE IN DRAINS, SCUPPERS, AND WATERWAYS.

17.07 SURFACE COATING: ENERGY STAR QUALIFIED, HIGHLY REFLECTIVE, ALIPHATIC URETHANE LIQUID-APPLIED WATERPROOFING MEMBRANE; SUITABLE FOR APPLICATION METHOD SPECIFIED.

17.08 MISCELLANEOUS ACCESSORIES: PROVIDE THOSE RECOMMENDED BY ROOFING SYSTEM MANUFACTURER.

ROOF INSULATION

18.01 PREFORMED INSULATION BOARDS APPROVED BY ROOFING SYSTEM MANUFACTURER, SELECTED FROM MANUFACTURER'S STANDARD SIZES SUITABLE FOR APPLICATION, AND OF THICKNESS REQUIRED TO ACHIEVE SPECIFIED R-VALUE.

18.02 POLYISOCYANURATE BOARD INSULATION: ASTM C1289, TYPE II, CLASS 1, GRADE 3, FELT OR GLASS-FIBER MAT FACER ON BOTH MAJOR SURFACES.

A. Thickness (Full Roof Tear-off): 1.5 inches (38.1 mm).

B. Thickness (Partial Roof Tear-off and Roof Re-cover): None.

18.03 TAPERED INSULATION: PROVIDE FACTORY-TAPERED INSULATION BOARDS.

A. Material: Match roof insulation.

B. Minimum Thickness: 1/4 inch (6.35 mm).

C. Slope:
   1. Roof Field: 1/4 inch (6.35 mm) per foot unless otherwise indicated on Drawings.
   2. Saddles and Crickets: 1/2 inch (12.7 mm) per foot unless otherwise indicated on Drawings.

18.04 PROVIDE PREFORMED SADDLES, CRICKETS, TAPERED EDGE STRIPS, AND OTHER INSULATION SHAPES WHERE INDICATED FOR SLOPING TO DRAIN. FABRICATE TO SLOPES INDICATED.

INSULATION ACCESSORIES

19.01 FASTENERS: FACTORY-COATED STEEL FASTENERS AND METAL OR PLASTIC PLATES COMPLYING WITH CORROSION-RESISTANCE PROVISIONS IN FM APPROVALS 4470, DESIGNED FOR FASTENING ROOF INSULATION AND COVER BOARDS TO SUBSTRATE, AND ACCEPTABLE TO ROOFING SYSTEM MANUFACTURER.

19.02 INSULATION ADHESIVE: INSULATION MANUFACTURER'S RECOMMENDED ADHESIVE FORMULATED TO ATTACH ROOF INSULATION TO SUBSTRATE OR TO ANOTHER INSULATION LAYER.

19.03 INSULATION CANT STRIPS: ASTM C208, TYPE II, GRADE 1, CELLULOSIC-FIBER INSULATION BOARD.

19.04 TAPERED EDGE STRIPS: ASTM C208, TYPE II, GRADE 1, CELLULOSIC-FIBER INSULATION BOARD.

19.05 COVER BOARD: ASTM C208, TYPE II, GRADE 2, CELLULOSIC-FIBER INSULATION BOARD, 1/2 INCH (12.7 MM) THICK.

ASPHALT MATERIALS

20.01 ROOFING ASPHALT: ASTM D312/D312M, TYPE IV, LOW-ODOR.

PART 3 EXECUTION

21.01 EXAMINATION

21.02 EXAMINE SUBSTRATES, AREAS, AND CONDITIONS, WITH INSTALLER PRESENT, FOR COMPLIANCE WITH REQUIREMENTS AND OTHER CONDITIONS AFFECTING PERFORMANCE OF THE WORK:

A. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.

B. Verify that cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation (if specified).

C. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

D. Any substrate found to be unsound shall be removed and replaced or repaired prior to the start of the roof installation.

21.03 PROCEED WITH INSTALLATION ONLY AFTER UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

PREPARATION

22.01 CLEAN SUBSTRATE OF DUST, DEBRIS, MOISTURE, AND OTHER SUBSTANCES DETRIMENTAL TO ROOFING INSTALLATION ACCORDING TO ROOFING SYSTEM MANUFACTURER'S WRITTEN INSTRUCTIONS. REMOVE SHARP PROJECTIONS.

22.02 PREVENT MATERIALS FROM ENTERING AND CLOGGING ROOF DRAINS AND CONDUCTORS AND FROM SPILLING OR MIGRATING ONTO SURFACES OF OTHER CONSTRUCTION. REMOVE ROOF-DRAIN PLUGS WHEN NO WORK IS TAKING PLACE OR WHEN RAIN IS FORECAST.

ROOFING INSTALLATION, GENERAL

23.01 INSTALL ROOFING SYSTEM ACCORDING TO ROOFING SYSTEM MANUFACTURER'S WRITTEN INSTRUCTIONS, FM APPROVALS' ROOFNAV ASSEMBLY REQUIREMENTS, AND FM GLOBAL PROPERTY LOSS PREVENTION DATA SHEET 1-29.

23.02 COMPLETE TERMINATIONS AND BASE FLASHINGS, AND PROVIDE TEMPORARY SEALS TO PREVENT WATER FROM ENTERING COMPLETED SECTIONS OF ROOFING SYSTEM AT THE END OF THE WORKDAY OR WHEN RAIN IS FORECAST.

A. Remove and discard temporary seals before beginning work on adjoining roofing.

23.03 INSTALL ROOF MEMBRANE AND AUXILIARY MATERIALS TO TIE IN TO EXISTING ROOFING TO MAINTAIN WEATHERTIGHTNESS OF TRANSITION.

23.04 ASPHALT HEATING:

A. Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.
   1. For cap sheets, heat asphalt according to cap sheet manufacturer's recommendations.

B. Circulate asphalt during heating.

C. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application.
   1. For cap sheets, comply with cap sheet manufacturer's recommendations.

D. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating.

E. Do not heat asphalt within 25 deg F of flash point.

F. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.

G. Apply hot roofing asphalt within plus or minus 25 deg F of equiviscous temperature.
   1. For cap sheets, comply with cap sheet manufacturer's recommendations.

23.05 SUBSTRATE-JOINT PENETRATIONS: PREVENT ROOFING ASPHALT AND ADHESIVES FROM PENETRATING SUBSTRATE JOINTS, ENTERING BUILDING, OR DAMAGING ROOFING SYSTEM COMPONENTS OR ADJACENT BUILDING CONSTRUCTION.

INSTALLATION OF INSULATION

24.01 COORDINATE INSTALLING ROOFING SYSTEM COMPONENTS, SO INSULATION IS NOT EXPOSED TO PRECIPITATION OR LEFT EXPOSED AT THE END OF THE WORKDAY.

24.02 COMPLY WITH ROOFING SYSTEM AND INSULATION MANUFACTURER'S WRITTEN INSTRUCTIONS FOR INSTALLING ROOF INSULATION.

24.03 INSTALLATION OVER METAL DECKING:

A. Install base layer of insulation with end joints staggered not less than 12 inches (304.8 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.
   1. Locate end joints over crests of decking.

2. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
3. Make joints between adjacent insulation boards not more than 1/4 inch (6.35 mm) in width.
4. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (609.6 mm).
    a. Trim insulation, so that water flow is unrestricted.
5. Fill gaps exceeding 1/4 inch (6.35 mm) with insulation.
6. Cut and fit insulation within 1/4 inch (6.35 mm) of nailers, projections, and penetrations.
7. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
    a. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

B. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (304.8 mm) from previous layer of insulation.
1. Install with long joints continuous and with end joints staggered not less than 12 inches (304.8 mm) in adjacent rows.
2. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
3. Make joints between adjacent insulation boards not more than 1/4 inch (6.35 mm) in width.
4. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (609.6 mm).
    a. Trim insulation, so that water flow is unrestricted.
5. Fill gaps exceeding 1/4 inch (6.35 mm) with insulation.
6. Cut and fit insulation within 1/4 inch (6.35 mm) of nailers, projections, and penetrations.
7. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
    a. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

INSTALLATION OF COVER BOARDS

25.01 INSTALL COVER BOARDS OVER INSULATION WITH LONG JOINTS IN CONTINUOUS STRAIGHT LINES, WITH END JOINTS STAGGERED BETWEEN ROWS. OFFSET JOINTS OF INSULATION BELOW A MINIMUM OF 6 INCHES (152.4 MM) IN EACH DIRECTION.

A. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

B. At internal roof drains, conform to slope of drain sump.
1. Trim cover board, so that water flow is unrestricted.

C. Cut and fit cover board tight to nailers, projections, and penetrations.

D. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
1. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

INSTALLATION OF ROOFING MEMBRANE, GENERAL

26.01 INSTALL ROOFING SYSTEM ACCORDING TO ROOFING SYSTEM MANUFACTURER'S WRITTEN INSTRUCTIONS AND APPLICABLE RECOMMENDATIONS IN ARMA/NRCA'S "QUALITY CONTROL GUIDELINES FOR THE APPLICATION OF POLYMER MODIFIED BITUMEN ROOFING."

26.02 START INSTALLATION OF ROOFING IN PRESENCE OF ROOFING SYSTEM MANUFACTURER'S TECHNICAL PERSONNEL.

26.03 COORDINATE INSTALLATION OF ROOFING SYSTEM SO INSULATION AND OTHER COMPONENTS OF THE ROOFING SYSTEM NOT PERMANENTLY EXPOSED ARE NOT SUBJECTED TO PRECIPITATION OR LEFT UNCOVERED AT THE END OF THE WORKDAY OR WHEN RAIN IS FORECAST.

A. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.

B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.

C. Remove and discard temporary seals before beginning work on adjoining roofing.

INSTALLATION OF BASE SHEET

27.01 BEFORE INSTALLING, UNROLL BASE SHEET, CUT INTO WORKABLE LENGTHS, AND ALLOW TO LIE FLAT FOR A TIME PERIOD RECOMMENDED BY MANUFACTURER FOR THE AMBIENT TEMPERATURE.

27.02 INSTALLATION OF SBS-MODIFIED BITUMEN POLYESTER AND FIBERGLASS-MAT BASE SHEET:

A. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

B. Extend roofing sheets over and terminate above cants.

C. Install base sheet in a shingle fashion.

D. Adhere to substrate in a solid mopping of hot roofing asphalt.

E. Install base sheet without wrinkles, tears, and free from air pockets.

F. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.
   1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76.2 mm)
   2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (304.8 mm).
   3. Stagger end laps not less than 18 inches (457.2 mm).
   4. Completely bond and seal laps, leaving no voids.
   5. Roll laps with a 20-pound roller.

G. Repair tears and voids in laps and lapped seams not completely sealed.

H. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

INSTALLATION OF SBS-MODIFIED BITUMINOUS CAP SHEET

28.01 BEFORE INSTALLING, UNROLL CAP SHEET, CUT INTO WORKABLE LENGTHS, AND ALLOW TO LIE FLAT FOR A TIME PERIOD RECOMMENDED BY MANUFACTURER FOR THE AMBIENT TEMPERATURE AT WHICH CAP SHEET WILL BE INSTALLED.

28.02 INSTALL MODIFIED BITUMINOUS ROOFING CAP SHEET ACCORDING TO ROOFING MANUFACTURER'S WRITTEN INSTRUCTIONS, STARTING AT LOW POINT OF ROOFING SYSTEM.

A. Extend cap sheet over and terminate above cants.

B. Install cap sheet in a shingle fashion.

C. Adhere to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by cap sheet manufacturer.

D. Install base sheet without wrinkles, tears, and free from air pockets.

E. Install cap sheet, so side and end laps shed water.

28.03 LAPS: ACCURATELY ALIGN ROOFING SHEETS, WITHOUT STRETCHING, AND MAINTAIN UNIFORM SIDE AND END LAPS.

A. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76.2 mm).

B. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (304.8 mm).

C. Stagger end laps not less than 18 inches (457.2 mm).

D. Completely bond and seal laps, leaving no voids.

E. Roll laps with a 20-pound roller.

F. Repair tears and voids in laps and lapped seams not completely sealed.

28.04 APPLY PRESSURE TO THE BODY OF THE CAP SHEET ACCORDING TO MANUFACTURER'S INSTRUCTIONS, TO REMOVE AIR POCKETS AND TO RESULT IN COMPLETE ADHESION OF BASE SHEET TO SUBSTRATE.

28.05 FLOOD COAT:

A. Install after cap sheets and modified flashing, tests, repairs and corrective actions have been completed and approved.

B. Apply flood coat materials in the quantities recommended by the manufacturer.

28.06 SURFACE COATINGS: APPLY ROOF COATINGS IN STRICT CONFORMANCE WITH THE MANUFACTURER’S RECOMMENDED PROCEDURES.

INSTALLATION OF FLASHING AND STRIPPING

29.01 INSTALL BASE FLASHING OVER CANT STRIPS AND OTHER SLOPED AND VERTICAL SURFACES, AT ROOF EDGES, AND AT PENETRATIONS THROUGH ROOF, AND SECURE TO SUBSTRATES ACCORDING TO ROOFING SYSTEM MANUFACTURER'S WRITTEN INSTRUCTIONS AND AS FOLLOWS:

A. Prime substrates with asphalt primer if required by roofing system manufacturer.

B. Backer-Sheet Application:
   1. Adhere backer sheet to substrate in a solid mopping of hot roofing asphalt.
   2. Seal all laps.

29.02 EXTEND BASE FLASHING UP WALLS OR PARAPETS A MINIMUM OF 8 INCHES (203.2 MM) ABOVE ROOFING MEMBRANE AND 4 INCHES (101.6 MM) ONTO FIELD OF ROOFING MEMBRANE.

29.03 MECHANICALLY FASTEN TOP OF BASE FLASHING SECURELY AT TERMINATIONS AND PERIMETER OF ROOFING.

A. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

B. Termination Bar: Provide a metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs. Fasten the bar a minimum of 8 inches (203.2 mm) o.c. to achieve constant compression. Provide suitable, sealant at the top edge if required.

29.04 INSTALL LIQUID FLASHING SYSTEM ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

A. Extend liquid flashing not less than 3 inches (76.2 mm) in all directions from edges of item being flashed.

B. Embed granules, matching color of roof membrane, into wet compound.

29.05 INSTALL ROOFING CAP-SHEET STRIPPING WHERE METAL FLANGES AND EDGINGS ARE SET ON ROOFING ACCORDING TO ROOFING SYSTEM MANUFACTURER'S WRITTEN INSTRUCTIONS.

29.06 FLASHING CAP PLY: INSTALL FLASHING CAP SHEETS BY THE SAME APPLICATION METHOD USED FOR THE CAP PLY.

A. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.

B. Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 100 sq feet (0.10764 sq cm) per gallon. Allow primer to dry tack free.

C. Adhere to the underlying base flashing ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203.2 mm) o.c. from the finished roof at all vertical surfaces.

D. Coordinate counterflashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.

E. Coordinate roof accessories, miscellaneous sheet metal accessory items with the roofing system work.

F. All stripping shall be installed prior to flashing cap sheet installation.

G. Heat and scrape granules when welding or adhering at cut areas and seams to granular surfaces at all flashings.

H. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed, or nailed 4 inches (101.6 mm) on center and covered with an acceptable counterflashing.

FIELD QUALITY CONTROL

30.01 INSPECTION: PROVIDE MANUFACTURER'S FIELD OBSERVATIONS NO LESS THAN ONCE PER WEEK.

A. Warranty shall be issued upon manufacturer's acceptance of the installation.

B. Field observations shall be performed by a Technical Representative employed full-time by the manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.

C. Provide observation reports from the Technical Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.

D. Provide a final report from the Technical Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

30.02 FINAL ROOF INSPECTION: ARRANGE FOR ROOFING SYSTEM MANUFACTURER'S TECHNICAL PERSONNEL TO INSPECT ROOFING INSTALLATION ON COMPLETION.

A. Notify Architect and Owner 48 hours in advance of date and time of inspection.

B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.

C. Repair or replace deteriorated or defective work found at time above inspection as required to a produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

D. Notify the Owner and Architect upon completion of corrections.

E. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.

30.03 ROOFING SYSTEM WILL BE CONSIDERED DEFECTIVE IF IT DOES NOT PASS INSPECTIONS.

A. Additional inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

PROTECTING AND CLEANING

31.01 PROTECT ROOFING SYSTEM FROM DAMAGE AND WEAR DURING REMAINDER OF CONSTRUCTION PERIOD.

A. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

31.02 CORRECT DEFICIENCIES IN OR REMOVE ROOFING SYSTEM THAT DOES NOT COMPLY WITH REQUIREMENTS, REPAIR SUBSTRATES, AND REPAIR OR REINSTALL ROOFING SYSTEM TO A CONDITION FREE OF DAMAGE AND DETERIORATION AT TIME OF SUBSTANTIAL COMPLETION AND ACCORDING TO WARRANTY REQUIREMENTS.

31.03 CLEAN OVERSPRAY AND SPILLAGE FROM ADJACENT CONSTRUCTION USING CLEANING AGENTS AND PROCEDURES RECOMMENDED BY MANUFACTURER OF AFFECTED CONSTRUCTION.

END OF SECTION

SECTION 076200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, exterior penetrations, and parapet caps.

B. Sealants for joints within sheet metal fabrications.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

C. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).

D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2024).

E. CDA A4050 - Copper in Architecture - Handbook; current edition.

F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.04 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

2.01 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal.

2.02 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 sheets. Return and brake edges.

2.03 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Underlayment: ASTM D226/D226M, organic roofing felt, Type I, No. 15.

C. Primer Type: Zinc chromate.

D. Concealed Sealants: Non-curing butyl sealant.

E. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

F. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 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, 0.015 inch (0.38 mm).

3.03 INSTALLATION

A. Comply with drawing details.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

3.04 FIELD QUALITY CONTROL

A. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

1.02 REFERENCE STANDARDS

A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

B. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

C. ASTM C1382 - Standard Test Method for Determining Tensile Adhesion Properties of Sealants when Used in Exterior Insulation and Finishing Systems (EIFS) Joints; 2016 (Reapproved 2023).

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include 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. Backing material recommended by sealant manufacturer.
   4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   5. Substrates the product should not be used on.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Executed warranty.

1.04 WARRANTY

A. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

B. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nonsag Sealants:
   1. Dow: www.dow.com/#sle.
   2. Henry Company: www.henry.com/#sle.
   3. Hilti, Inc: www.hilti.com/#sle.
   4. Sika Corporation: usa.sika.com/#sle.
   5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   6. Substitutions: allowed as reviewed by Architect.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints:
      a. Do not seal exterior joints unless indicated on drawings as sealed.
      b. Seal the following joints:
         1) Joints between doors, windows, and other frames or adjacent construction.
         2) Joints between different exposed materials.

2. Do Not Seal:
    a. Intentional weep holes in masonry.
    b. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
    c. Joints where sealant installation is specified in other sections.

B. Exterior Joints: Use nonsag silyl-terminated polyether/polyurethane sealant, unless otherwise indicated.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with acceptable levels of volatile organic compound (VOC) content; see Section 016116.

2.04 NONSAG JOINT SEALANTS

A. Low Modulus, Silyl-Terminated Polyether (STPE) Joint Sealant: ASTM C920, Type S, Grade NS, Uses NT, A, M, Class 100/50. Tested in accordance with ASTM C1382.
    1. Movement Capability: Plus and minus 50 percent, minimum.
    2. Color: Match adjacent finished surfaces.

2.05 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying 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.

END OF SECTION

SECTION 081116
ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush aluminum doors with aluminum face sheets.

B. Aluminum frames.

1.02 REFERENCE STANDARDS

A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.

B. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

G. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

H. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2023.

1.03 SUBMITTALS

A. Product Data: Manufacturer's descriptive literature for each type of door; include information on fabrication methods.

B. Shop Drawings: Include elevations of each opening type.
   1. Verify dimensions by field measurements before fabrication and indicate on shop drawings.

C. Verification Samples: Two actual pieces of products in each finish specified, not less than 6 inches (150 mm) square or 6 inches (150 mm) long for linear components. For finishes subject to color variation, include not less than two samples illustrating extreme range to be anticipated.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

F. Specimen warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver aluminum components in manufacturer's standard protective packaging, palleted, crated, or banded together.

B. Inspect delivered components for damage and replace. Repaired components will not be accepted.

C. Store components in clean, dry, indoor area, under cover in manufacturer's packaging until installation.

D. Protect materials and finish from damage during handling and installation.

1.05 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

B. Manufacturer Warranty: Provide 10-year manufacturer warranty for defects in workmanship and materials. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flush Aluminum Doors with Aluminum Face Sheets:
   1. Cline Aluminum Doors, Inc; Series 100BE: www.clinedoors.com/#sle.
   2. Substitutions: allowed as reviewed by Architect.

B. Aluminum Frames:
   1. Cline Aluminum Doors, Inc; Series 100B, 5-inch TS Frames, Open Back: www.clinedoors.com/#sle.
   2. Substitutions: allowed as reviewed by Architect.

2.02 PERFORMANCE REQUIREMENTS

A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.

B. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 7.5 psf (359 Pa).

C. Condensation Resistance Factor: 50, measured in accordance with AAMA 1503.

2.03 MATERIALS

A. Aluminum Sheet: ASTM B209/B209M, alloy 5005, temper H14, stretcher leveled.

B. Extruded Aluminum: ASTM B221 (ASTM B221M), alloy 6063, temper T5, or alloy 6463, temper T5.

2.04 FINISHES

A. Class I Natural Anodized Finish: Clear anodic coating; AAMA 611 AA-M12C22A41, minimum dry film thickness (DFT) of 0.7 mils, 0.0007 inch (0.018 mm).

B. Color: As selected by Architect from manufacturer's standard line.

2.05 ACCESSORIES

A. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.

B. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A123/A123M.

C. Bituminous Coating: Cold-applied asphaltic mastic, compounded for 30-mil (0.76 mm) thickness per coat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.

B. Replace components with damage to exposed finishes.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and approved shop drawings.

B. Install exterior doors and frames in accordance with ASTM E2112.

C. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.

D. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.

E. Hang doors and adjust hardware to achieve specified clearances and proper door operation.

F. Install door hardware. See Section 087100.

3.04 FIELD QUALITY CONTROL

A. Provide services of aluminum door manufacturer's field representative to observe for proper installation of system and submit report.

3.05 CLEANING

A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609 & 610.

B. Do not use abrasive, caustic, or acid cleaning agents.

3.06 PROTECTION

A. Protect products of this section from damage caused by subsequent construction until Date of Substantial Completion.

B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

END OF SECTION

SECTION 083323
CORROSION RESISTANT OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASCE 7-10 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2010.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

1.02 1.1 SUMMARY

A. A. Section Includes: Manually operated overhead insulated rolling doors.

1.2 SYSTEM DESCRIPTION

A. DESIGN REQUIREMENTS:

1. AIR INFILTRATION TO COMPLY WITH:

A. ASHRAE® (AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR-CONDITIONING ENGINEERS) STANDARD 90.1-2007, 2010 & 2013 REQUIREMENTS OF LESS THAN .3 CFM/FT2

B. IECC® (INTERNATIONAL ENERGY CONSERVATION CODE) 2012 REQUIREMENTS OF LESS THAN 1.0 CFM/FT2

2. WIND LOADING:

A. SUPPLY DOORS TO WITHSTAND DESIGN WIND LOAD PER MANUFACTURER'S STANDARD FOR THE INTENDED GEOGRAPHIC AREA.

3. CYCLE LIFE:

A. DESIGN DOORS OF STANDARD CONSTRUCTION FOR NORMAL USE OF UP TO 20 CYCLES PER DAY MAXIMUM, AND AN OVERALL MAXIMUM OF 50,000 OPERATING CYCLES FOR THE LIFE OF THE DOOR

4. SEISMIC PERFORMANCE:

A. FLAME SPREAD INDEX OF 0 AND A SMOKE DEVELOPED INDEX OF 10 AS TESTED PER ASTM E84

1.3 SUBMITTALS

A. SUBMIT THE FOLLOWING ITEMS:

1. PRODUCT DATA

2. SHOP DRAWINGS: INCLUDE SPECIAL CONDITIONS NOT DETAILED IN PRODUCT DATA. SHOW INTERFACE WITH ADJACENT WORK.

3. QUALITY ASSURANCE/CONTROL SUBMITTALS:

17.01 A. PROVIDE MANUFACTURER ISO 9001:2015 REGISTRATION

17.02 C. PROVIDE MANUFACTURER'S INSTALLATION INSTRUCTION

4. CLOSEOUT SUBMITTALS:

18.01 A. OPERATION AND MAINTENANCE MANUAL

1.4 QUALITY ASSURANCE

A. QUALIFICATIONS:

1. MANUFACTURER QUALIFICATIONS: ISO 9001:2015 REGISTERED AND A MINIMUM OF FIVE YEARS' EXPERIENCE IN PRODUCING DOORS OF THE TYPE SPECIFIED

2. INSTALLER QUALIFICATIONS: MANUFACTURER'S APPROVAL

1.5 DELIVERY STORAGE AND HANDLING

1.6 WARRANTY

A. STANDARD WARRANTY: TWO YEARS FROM DATE OF SHIPMENT AGAINST DEFECTS IN MATERIAL AND WORKMANSHIP

PART 2 PRODUCTS

26.01 2.1 MANUFACTURER

A. MANUFACTURER:

1. CORNELL: 24 ELMWOOD AVENUE, MOUNTAIN TOP, PA 18707. SUBSTITIONS: ALLOWED IF PERFORMANCE AND QUALITY LEVEL ARE EQUAL TO OR EXCEED THE BASIS OF DESIGN PRODUCT.

A. MODEL: ESD20CR

2.3 MATERIALS

A. CURTAIN: AIR INFILTRATION RATE OF LESS THAN .3 CFM/FT2, AS TESTED PER ASTM E283 VALIDATED BY AN INDEPENDENT TESTING AGENCY. TEST REPORT REQUIRED.

1. FABRICATION:

SLAT MATERIAL: NO. 6F, (LISTED EXTERIOR/INTERIOR):

33.01 1) ALUMINUM/ALUMINUM: 0.040-INCH (0.04 INCH (1.02 MM)) ALUMINUM

33.02 B. INSULATION: 7/8 INCH (22.22 MM) FOAMED-IN-PLACE, CLOSED CELL URETHANE

33.03 C. TOTAL SLAT THICKNESS: 15/16 INCH (23.81 MM)

D. FLAME SPREAD INDEX OF 0 AND A SMOKE DEVELOPED INDEX OF 10 AS TESTED PER ASTM E84

34.01 E. R-VALUE: 8.0

2. EXTERIOR & INTERIOR SLAT FINISH:

A. ALUMINUM: CLEAR ANODIZED

B. ENDLOCKS: ALTERNATE SLATS EACH SECURED WITH TWO ¼" (0.25 INCH (6.35 MM)) STAINLESS STEEL RIVETS. FABRICATE INTERLOCKING SECTIONS WITH HIGH STRENGTH STAMPED 304 SERIES STAINLESS STEEL. PROVIDE ENDLOCKS/WINDLOCKS AS REQUIRED TO MEET SPECIFIED WIND LOAD.

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C. BOTTOM BAR

A. EXTRUDED ALUMINUM: EXTRUDED ALUMINUM ALLOY 6063-T5

2. FINISH:

A. ALUMINUM: CLEAR ANODIZED

D. GUIDES:

A. THERMAL BREAK REQUIRED. MINIMUM 3/16 INCH (4.76 MM) STAINLESS STEEL ANGLES. PROVIDE WINDLOCK BARS OF SAME MATERIAL WHEN WINDLOCKS ARE REQUIRED TO MEET SPECIFIED WIND LOAD. TOP OF INNER AND OUTER GUIDE ANGLES TO BE FLARED OUTWARDS TO FORM BELLMOUTH FOR SMOOTH ENTRY OF CURTAIN INTO GUIDES. PROVIDE REMOVABLE GUIDE STOPPERS TO PREVENT OVER TRAVEL OF CURTAIN AND BOTTOM BAR. STAINLESS STEEL FASTENERS TO BE USED FOR ASSEMBLY BOLTS.

2. FINISH:

A. ALUMINUM: CLEAR ANODIZED

E. COUNTERBALANCE SHAFT ASSEMBLY:

1. BARREL: STEEL PIPE CAPABLE OF SUPPORTING CURTAIN LOAD WITH MAXIMUM DEFLECTION OF 0.03 INCHES (0.76 MM) PER FOOT (0.1 INCH (2.5 MM) PER METER) OF WIDTH

2. SPRING BALANCE: OIL-TEMPERED, HEAT-TREATED STEEL HELICAL TORSION SPRING ASSEMBLY DESIGNED FOR PROPER BALANCE OF DOOR TO ENSURE THAT MAXIMUM EFFORT TO OPERATE WILL NOT EXCEED 25 LBS (110 N). PROVIDE WHEEL FOR APPLYING AND ADJUSTING SPRING TORQUE.

3. FINISH:

A. CORROSION INHIBITIVE: ZIRCONIUM TREATMENT FOLLOWED BY A CORROSION INHIBITIVE BAKED-ON ZINC-RICH GRAY POLYESTER POWDER COAT; MINIMUM 2.5 MILS (0 INCH (0.06 MM)) CURED FILM THICKNESS

F. BRACKETS:

1. FINISH:

A. #4 TYPE 304 STAINLESS STEEL

G. HOOD:

A. Minimum (0.04 inch (1.02 mm)) aluminum] with reinforced top and bottom edges. Provide minimum 1/4-inch (0.25 inch (6.35 mm)) steel intermediate support brackets as required to prevent excessive sag.

B. 1. Finish:

A. ALUMINUM CLEAR ANODIZED

H. WEATHERSTRIPPING:

1. BOTTOM BAR:

A. MANUFACTURER'S STANDARD FOR MANUALLY OPERATED DOORS.

2. GUIDES: REPLACEABLE VINYL STRIP ON GUIDES SEALING AGAINST FASCIA SIDE OF CURTAIN

3. LINTEL SEAL: DOUBLE BRUSH SEAL WITH EPDM SANDWICHED BETWEEN THE TWO BRUSH SEALS AT DOOR HEADER TO IMPEDE AIR FLOW.

4. HOOD: NEOPRENE/RAYON BAFFLE TO IMPEDE AIR FLOW ABOVE COIL

OPERATION

A. A. Manufacturer's standard for manually operated doors.

2.5 ACCESSORIES

A. LOCKING:

B. TRIM PACKAGE: MINIMUM 16-GAUGE #4 TYPE 304 FINISH STAINLESS STEEL

C. STRIP DOOR BRACKET: ASSEMBLY INTEGRAL TO COILING DOOR TO HANG STRIP DOOR ON INTERIOR OF BUILDING. CONTACT FACTORY FOR SIZES GREATER THAN 12'-0" X 12-0". POWDER COATED FINISH TO MATCH COILING DOOR.

PART 3 EXECUTION

68.01 3.1 EXAMINATION

A. EXAMINE SUBSTRATES UPON WHICH WORK WILL BE INSTALLED AND VERIFY CONDITIONS ARE IN ACCORDANCE WITH APPROVED SHOP DRAWINGS

A. B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates

B. C. Commencement of work by installer is acceptance of substrate

3.2 INSTALLATION

A. GENERAL: INSTALL DOOR AND OPERATING EQUIPMENT WITH NECESSARY HARDWARE, ANCHORS, INSERTS, HANGERS AND SUPPORTS

A. B. Follow manufacturer's installation instructions

3.3 ADJUSTING

A. FOLLOWING COMPLETION OF INSTALLATION, INCLUDING RELATED WORK BY OTHERS, LUBRICATE, TEST, AND ADJUST DOORS FOR EASE OF OPERATION, FREE FROM WARP, TWIST, OR DISTORTION

3.4 CLEANING

A. A. Clean surfaces soiled by work as recommended by manufacturer.

B. B. Remove surplus materials and debris from the site

3.5 DEMONSTRATION

A. A. Demonstrate proper operation to Owner's Representative

B. B. Instruct Owner's Representative in maintenance procedures

END OF SECTION

SECTION 087100
DOOR HARDWARE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. BHMA A156.1 - Standard for Butts and Hinges; 2021.

B. BHMA A156.3 - Exit Devices; 2025.

C. BHMA A156.4 - Door Closers and Pivots; 2024.

D. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.

E. BHMA A156.28 - Standard for Recommended Practices for Mechanical Keying Systems; 2023.

F. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

G. UL 305 - Standard for Panic Hardware; Current Edition, Including All Revisions.

1.02 SUMMARY

A. Section includes:
   1. Mechanical door hardware

B. Related Sections:
   1. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.

1.03 REFERENCES

A. UL LLC
   1. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute
   1. Sequence and Format for the Hardware Schedule
   2. Installation Guide for Doors and Hardware

C. ANSI - American National Standards Institute
   1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
   2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
   3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems

1.04 SUBMITTALS

A. General:
   1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
   2. Prior to forwarding submittal:
      a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
      b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:
   1. Product Data: Submit 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. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

3. Door Hardware Schedule:
   a. Submit 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 critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:
      1) Door Index: door number, heading number, and Architect's hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.
      3) Name and manufacturer of each item.
      4) Fastenings and other pertinent information.
      5) Location of each hardware set cross-referenced to indications on Drawings.
      6) Explanation of all abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for hardware.
      8) Door and frame sizes and materials.
      9) Degree of door swing and handing.
4. Key Schedule:
   a. After Keying Conference, provide keying schedule that includes levels of keying, explanations 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. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   d. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:
1. Provide Product Data:
   a. Include warranties for specified door hardware.

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. Final approved hardware schedule edited to reflect conditions as installed.
   d. Final keying schedule
   e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.05 QUALITY ASSURANCE

A. Qualifications and Responsibilities:
1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project’s vicinity. Supplier to have on staff, a certified

Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: 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:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Pre-Installation Meetings
   1. Keying Conference
      a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
         1) Function of building and degree of security required.
         2) Address for delivery of keys.
   2. Pre-installation Conference
      a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
      b. Inspect and discuss preparatory work performed by other trades.
      c. Review questions or concerns related to proper installation and adjustment of door hardware.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

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. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.07 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop 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.

1.08 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            (a) Schlage L Series: 10 years
            (b) Schlage ND Series: 10 years
            (c) Schlage ALX Series: 10 years
        2) Exit Devices
            (a) Von Duprin: 10 years
        3) Closers
            (a) LCN 4050 Series: 25 years

1.09 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with Section 01. Prior bid approval by Architect/Owner.

B. 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.

C. 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.

2.02 MATERIALS

A. Fabrication
    1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
    2. Finish exposed 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 wherever possible for hardware units exposed when door is closed. Coordinate with "Aluminum Doors and Frames" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

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.

2.03 HINGES

A. Manufacturers and Products:
    1. Scheduled Manufacturer and Product:
        a. Ives 5BB series
    2. Acceptable Manufacturer
        a. No Substitute

B. Requirements:
   1. Provide hinges conforming to ANSI/BHMA A156.1.
   2. Provide five knuckle, ball bearing hinges.
   3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914.4 mm) wide:
      a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   4. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
   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. 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

2.04 EXIT DEVICES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product:
      a. Von Duprin 99/33A series
   2. Acceptable Manufacturer
      a. No Substitute

B. Requirements:
   1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
   2. Cylinders: Refer to "KEYING" article, herein.
   3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
   4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
   5. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
   6. Provide flush end caps for exit devices.
   7. Provide exit devices with manufacturer's approved strikes.
   8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
   9. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
   10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
   11. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
   12. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.

2.05 CYLINDERS

A. Manufacturers:
   1. Scheduled Manufacturer and Product:
      a. Schlage Fixed/Conventional Keying
   2. Acceptable Manufacturer
      a. No Substitute

B. Requirements:
   1. Provide cylinders/cores to match Owner’s existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer’s series as indicated. Refer to “KEYING” article, herein.

2.06 KEYING

A. Scheduled System:
   1. New factory registered system:
      a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
   2. Existing non-factory registered system:
      a. Provide cylinders/cores keyed into Owner's existing keying system managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference. Contact:
         1) Firm Name:
         2) Contact Person:
         3) Telephone:

B. Requirements:
   1. Construction Keying:
      a. Temporary Construction Cylinder Keying.
         1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
            (a) Split Key or Lost Ball Construction Keying System.
            (b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
         2) Owner or Owner's Representative will void operation of temporary construction keys.
   2. Permanent Keying:
      a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
         1) Master Keying system as directed by the Owner.
      b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
      c. Provide keys with the following features:
         1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
         2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
      d. Identification:
         1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
         2) Identification stamping provisions must be approved by the Architect and Owner.
         3) 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.
         4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
         5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
      e. Quantity: Furnish in the following quantities.
         1) Permanent Control Keys: 3.
         2) Master Keys: 6.
         3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
         4) Key Blanks: Quantity as determined in the keying meeting.

2.07 KEY CONTROL SYSTEM

A. Manufacturers:
   1. Scheduled Manufacturer:

a. Telkee
2. Acceptable Manufacturer
a. No Substitute

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.

2.08 DOOR CLOSERS

A. Manufacturers and Products:
1. Scheduled Manufacturer and Product:
a. LCN 4050A series
2. Acceptable Manufacturer
a. No Substitute

B. Requirements:
1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-1/2-inch 1.5 inch (38 mm) diameter with 11/16-inch (0.67 inch (17 mm)) diameter heat-treated pinion journal and full complement bearings.
4. Hydraulic Fluid: Fireproof, passing requirements of UL 10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees Fahrenheit (48.89 degrees Celsius) to -30 degrees Fahrenheit (-1.11 degrees Celsius).
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide stick on templates, 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.

2.09 PROTECTION PLATES

A. Manufacturers:
1. Scheduled Manufacturer:
a. Ives
2. Acceptable Manufacturer
a. No Substitute

B. Requirements:
1. Provide protection plates with a minimum of 0.050 inch (1.27 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (50.8 mm) less width of door on single doors.

2.10 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:
1. Scheduled Manufacturer:
a. Zero International
2. Acceptable Manufacturer
a. No Substitute

B. Requirements:
   1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
   2. Size thresholds 1/2 inch (12.7 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.11 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:
   1. Hinges at Exterior Doors: BHMA 630 (US32D)
   2. Protection Plates: BHMA 630 (US32D)
   3. Door Closers: Powder Coat to Match
   4. Thresholds: Mill Finish Aluminum

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
   1. Installation Guide for Doors and Hardware: DHI TDH-007-20

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.

H. Lock Cylinders:
   1. Install construction cylinders to secure building and areas during construction period.
   2. Furnish permanent keys to Owner for installation.

I. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

J. Door Closers : Mount closers inside of exterior doors.

K. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

L. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 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. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions 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.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Abbreviation	Name
IVE	H.B. Ives
LCN	LCN Commercial Division
SCH	Schlage Lock Company
VON	Von Duprin
ZER	Zero International Inc

132640 OPT0424663 VERSION 1, 05.16.25

LEGEND:

□LINK TO CATALOG CUT SHEET

HARDWARE GROUP NO. 01

FOR USE ON DOOR #(S):

101B	101C				

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	□		630	IVE
1	EA	PANIC HARDWARE	99-L-NL-06	□		626	VON

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	RIM CYLINDER	20-022	□		626	SCH
1	EA	SURFACE CLOSER	4050A SCUSH	□		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	□		630	IVE
1	EA	RAIN DRIP	142AA	□		AA	ZER
1	EA	DOOR SWEEP	39A	□		A	ZER
1	EA	THRESHOLD	8655A	□		A	ZER
	EA	SEALS	PROVIDED BY ALUM DOOR/FRAME MFG				

HARDWARE GROUP NO. RU-01

FOR USE ON DOOR #(S):

101A					

PROVIDE EACH RU DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	ALL HARDWARE	BY OPENING MANUFACTURER				

END OF SECTION

SECTION 099113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 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.

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. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
   7. Floors, unless specifically indicated.
   8. Glass.
   9. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Shop-primed items.

B. Section 099600 - High-Performance Coatings.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

1.05 SUBMITTALS

A. 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. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

C. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. 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.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.
   2. Label each container with color in addition to the manufacturer's label.

1.06 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 three years experience and approved by manufacturer.

1.07 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.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

2.02 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. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each paint material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
   1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

b. Architectural coatings VOC limits of the State in which the Project is located.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

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.

E. Colors: As indicated in Color Schedule.
1. Selection to be made by Architect after award of contract.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal and EIFS .
1. Two top coats and one coat primer.
2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.
3. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 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. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Contractor of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. 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. Exterior Plaster and Stucco: 12 percent.

3.02 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. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

G. 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. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

H. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

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. Sand metal surfaces lightly between coats to achieve required finish.

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.

3.04 FIELD QUALITY CONTROL

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 099600
HIGH PERFORMANCE COATINGS

PART I GENERAL

NOTE: STONHARD STONCHEM 802 IS "BASIS OF DESIGN." SUBSTITUTIONS OF EQUIVALENT OR BETTER PERFORMANCE AND QUALITY MAY BE ACCEPTED IF SUBMITTED PRIOR TO BID OPENING DATE.

2.01 1.01 RELATED DOCUMENTS

2.02 A. DRAWINGS AND GENERAL PROVISIONS OF CONTRACT, INCLUDING GENERAL AND SUPPLEMENTARY CONDITIONS AND DIVISION 1 SPECIFICATION SECTIONS, APPLY TO THIS SECTION.

2.03 1.02 SUMMARY

2.04 A. DEFINITIONS: RESINOUS LINING INCLUDES A PENETRATING TWO-COMPONENT VINYL ESTER PRIMER, A THREE-COMPONENT MORTARCOAT CONSISTING OF VINYL ESTER RESIN, PEROXIDE FREE RADICAL INITIATOR AND FINELY DIVIDED MINERAL COMPOSITE AGGREGATE AND A HIGHLY IMPERMEABLE, MINERAL COMPOSITE, VINYL ESTER TOPCOAT.

2.05 1.03 SUBMITTALS

2.06 A. PRODUCT DATA: SUBMIT MANUFACTURER'S TECHNICAL DATA, INSTALLATION INSTRUCTIONS, AND GENERAL RECOMMENDATIONS FOR EACH RESINOUS LINING MATERIAL REQUIRED. INCLUDE CERTIFICATION INDICATING COMPLIANCE OF MATERIALS WITH REQUIREMENTS.

2.07 B. SAMPLES: SUBMIT, FOR VERIFICATION PURPOSES, 4-INCH SQUARE SAMPLES OF EACH TYPE OF RESINOUS LINING REQUIRED, APPLIED TO A RIGID BACKING, IN COLOR AND FINISH INDICATED.

2.08 1.04 QUALITY ASSURANCE

2.09 A. SINGLE SOURCE RESPONSIBILITY: OBTAIN PRIMARY RESINOUS LINING MATERIALS INCLUDING PRIMERS, RESINS, HARDENING AGENTS, FINISH OR SEALING COATS FROM A SINGLE MANUFACTURER WITH NOT LESS THAN TEN YEARS OF SUCCESSFUL EXPERIENCE IN MANUFACTURING AND INSTALLING PRINCIPAL MATERIALS DESCRIBED IN THIS SECTION. CONTRACTOR SHALL HAVE COMPLETED AT LEAST FIVE PROJECTS OF SIMILAR SIZE AND COMPLEXITY; STONHARD OR APPROVED EQUAL. PROVIDE SECONDARY MATERIALS ONLY OF TYPE AND FROM SOURCE RECOMMENDED BY MANUFACTURER OF PRIMARY MATERIALS.

2.10 B. PRE-INSTALLATION CONFERENCE

A. General Contractor shall arrange a meeting not less than thirty days prior to starting work.
   1. 2. Attendance
      a. a. General Contractor
      b. b. Architect/Owner's Representative
      c. c. Manufacturer/Installer's Representative

2.11 1.05 DELIVERY, STORAGE AND HANDLING

2.12 A. MATERIAL SHALL BE DELIVERED TO JOB SITE AND CHECKED BY LINING CONTRACTOR FOR COMPLETENESS AND SHIPPING DAMAGE PRIOR TO JOB START.

2.13 B. ALL MATERIALS USED SHALL BE FACTORY PRE-WEIGHED AND PRE-PACKAGED IN SINGLE, EASY TO MANAGE BATCHES TO ELIMINATE ON-SITE MIXING ERRORS. NO ON-SITE WEIGHING OR VOLUMETRIC MEASUREMENTS ALLOWED.

2.14 C. MATERIAL SHALL BE STORED IN A DRY, ENCLOSED AREA PROTECTED FROM EXPOSURE TO MOISTURE. TEMPERATURE OF STORAGE AREA SHALL BE MAINTAINED BETWEEN 50 TO 75OF/10 TO 24OC.

2.15 1.06 PROJECT CONDITIONS

2.16 A. CONCRETE SUBSTRATE SHALL BE DENSE, FREE OF VOIDS, FINS, HONEYCOMBS AND OTHER IMPERFECTIONS. HORIZONTAL SURFACES SHALL HAVE A "ONCE OVER" STEEL TROWEL FINISH (WOOD FLOAT, BROOM OR MACHINE TROWEL FINISHES ARE UNACCEPTABLE). FINISH CONCRETE TO THE REQUIRED GRADE, LESS ALLOWANCE FOR OVERLAYMENT THICKNESS. A VAPOR BARRIER SHALL BE PRESENT FOR CONCRETE ON OR BELOW GRADE TO PREVENT OSMOTIC PRESSURE FORCES FROM AFFECTING ADHESION OF OVERLAYMENT. CURE CONCRETE 30 DAYS MINIMUM AND CONDUCT THE FOLLOWING TESTS PRIOR TO APPLICATION OF OVERLAYMENT:

1. 1. Test for "bird baths," if complete drainage is critical, by flooding horizontal surfaces with water and marking unacceptable areas. Unacceptable areas are to be corrected prior to application of overlayment.
2. 2. Test for unacceptable moisture content in concrete by the "plastic sheet" method (Ref. ((ASTM D4263))). The number of test sites shall be representative for the scope of work.
3. 3. Test for acceptable concrete surface tensile strength of 200 psi (1378.95 kPa) minimum by using a "pull-off test" (Ref. ((ASTM D4541))) in which a 1.0 inch (25.4 mm) diameter hole is cut into the concrete. Using a polymer adhesive, glue a 0.8 inch (20.32 mm) diameter dolly to the area cut in the concrete. The number of test sites shall be representative for the scope of the work.
4. 4. All patching and repair materials must be compatible with the overlayment and must be tested for acceptable surface tensile strength of 200 psi (1378.95 kPa) minimum by using "pull-off test" (Ref. A.3. above). The number of test sites shall be representative for the scope of the work.
5. 5. Test for substrate temperature by using a surface dial thermometer or equal. Temperature shall be equal to or greater than the minimum temperature recommended by the overlayment material manufacturer. Generally, ideal temperature range is between 60 to 80°F/16 to 27°C. Material should not be applied if humidity is above 85%. Substrate temperatures should be greater than 5□F/3°C above the dew point.
6. 6. Inspect for contamination, such as oil, grease, or chemical spills. Contamination must be removed prior to application of overlayment.

2.17 C. JOB AREA TO BE FREE OF OTHER TRADES DURING, AND FOR A PERIOD OF 24 HOURS, AFTER LINING INSTALLATION.

2.18 D. PROTECTION OF FINISHED LINING FROM DAMAGE BY SUBSEQUENT TRADES SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR.

2.19 1.07 WARRANTY

2.20 A. MANUFACTURER SHALL FURNISH A SINGLE, WRITTEN WARRANTY COVERING BOTH MATERIAL AND WORKMANSHIP FOR A PERIOD OF ONE (1) FULL YEAR FROM DATE OF INSTALLATION.

PART II PRODUCTS

3.01 2.01 COLORS

3.02 A. COLORS: AVAILABLE IN MANUFACTURER'S GRAY ONLY.

3.03 2.02 VINYL ESTER LINING

1. 1. Physical Properties: Provide lining system in which physical properties of topping, when tested in accordance with standards or procedures referenced below, are as follows:
    a. Tensile Strength 3,000 psi (20684.28 kPa)
    b. (((ASTM D638)))
    c. Flexural Strength 7,000 psi (48263.32 kPa)
    d. (((ASTM C580)))
    e. Hardness 85-90
    f. (((ASTM D2240)), Shore D)
    g. Bond Strength ???400 psi (2757.90 kPa)
    h. (((ASTM D4541))) (100% concrete failure)
    i. Abrasion Resistance 0.10 gm max. weight loss
    j. (((ASTM D4060)), CS-17)
    k. Flexural Modulus of Elasticity 5 x 105 psi (723.95 kPa)
    l. (((ASTM C580)))
    m. Thermal Coefficient of
    n. Linear Expansion 2 x 10-5 inch (127 mm)./in.oC
    o. (ASTM C-531)
    p. Cure Rate 24 hours for normal operations
    q. (@ 70°F/21°C)

3.04 2.03 ENGINEERING DETAILS

3.05 A. POINTS OF TERMINATION

1. 1. Edges shall be chased to “lock” the lining into the concrete.
2. 2. Tank perimeters shall be treated in one of three methods as specified by the Owner prior to bid:

3.06 A. LINING SHALL TERMINATE AT TANK PERIMETER WITHOUT SEALING PERIMETER EDGE, TO ALLOW DETECTION OF LEAKS THAT MAY OCCUR UNDER THE TANK.

3.07 B. LINING SHALL TERMINATE AT TANK PERIMETER WITH A COMPATIBLE ELASTOMER SEALING THE INTERFACE BETWEEN THE LINING AND THE TANK.

A. c. Lining shall lap and seal onto the perimeter of the tank by bridging over compatible elastomer at the tank/slab interface to compensate for possible movement.

1. 3. Equipment support legs shall be treated in one of the two methods described in 2.b. or 2.c. above as specified by the Owner prior to bid.
2. 4. Trench drains shall be treated in one of three methods as specified by the Owner prior to bid:

3.08 A. STEEL ANGLE TRENCH LIP MUST BE ANCHORED TO PREVENT MOVEMENT BETWEEN THE STEEL AND CONCRETE. LINING SHALL BE CHASED TO "LOCK" THE LINING WHERE IT TERMINATES AT THE ANGLE. STEEL ANGLE WILL BE COATED WITH MATERIAL COMPATIBLE WITH THE LINING MATERIAL OR WILL REMAIN UNCOATED AT OWNER'S OPTION.

3.09 B. PREFABRICATED POLYMER OR ALLOY TRENCHES MUST BE ANCHORED TO PREVENT MOVEMENT BETWEEN THE CONCRETE AND TRENCH. LINING SHALL BE CHASED TO "LOCK" THE LINING WHERE IT TERMINATES AT THE TRENCH.

A. c. Concrete trench will be lined to maintain monolithic protection. "Cold Joint" will be treated by lining manufacturer to assure bridging of potential cracks.

1. 5. Pipe drains shall be treated by chasing the lining to "lock" in place at point of termination. Pipe drain must be anchored to prevent movement between concrete and trench.
2. 6. Pipe chases shall be treated by having the lining lap and seal onto the perimeter of the pipe chase.

3.10 B. JOINTS AND CRACKS

1. 1. Control joints shall be treated by lining manufacturer to assure bridging of potential cracks and to maintain monolithic protection.
2. 2. Cold joints or construction joints shall be treated by lining manufacturers to assure bridging potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
3. 3. Vertical and horizontal expansion/contraction joints shall be honored by installing backer rod and compatible sealant after lining is installed. Sealant shall be sufficient to handle traffic conditions and chemical exposures in area.
4. 4. Cracks in vertical or horizontal concrete substrates shall be treated by lining manufacturer to assure bridging of cracks and to maintain monolithic protection.

PART III EXECUTION

4.01 3.01 PREPARATION

4.02 A. SUBSTRATE: CONCRETE PREPARATION SHALL BE BY MECHANICAL MEANS AND INCLUDE USE OF A SCABBLER, SCARIFIER OR SHOT BLAST MACHINE FOR REMOVAL OF BOND INHIBITING MATERIALS SUCH AS CURING COMPOUNDS OR LAITANCE.

4.03 3.02 APPLICATION

4.04 A. GENERAL: APPLY EACH COMPONENT OF RESINOUS LINING SYSTEM IN COMPLIANCE WITH MANUFACTURER'S DIRECTIONS TO PRODUCE A UNIFORM MONOLITHIC WEARING SURFACE OF THICKNESS INDICATED, UNINTERRUPTED EXCEPT AT DIVIDER STRIPS, SAW JOINTS OR OTHER TYPES OF JOINTS (IF ANY), INDICATED OR REQUIRED.

4.05 B. PRIMER: MIX AND APPLY PRIMER OVER PROPERLY PREPARED SUBSTRATE WITH STRICT ADHERENCE TO MANUFACTURER'S INSTALLATION PROCEDURES AND COVERAGE RATES.

4.06 C. MORTARCOAT: MIX MORTARCOAT ACCORDING TO MANUFACTURER'S RECOMMENDED PROCEDURES. APPLY MIXED MATERIAL OVER SURFACE WITH STRICT ADHERENCE TO MANUFACTURER'S INSTALLATION PROCEDURES.

4.07 D. TOPCOAT: MIX AND APPLY MINERAL COMPOSITE TOPCOAT OVER PROPERLY CURED MORTAR COAT WITH STRICT ADHERENCE TO MANUFACTURER'S INSTALLATION PROCEDURES.

4.08 3.03 FIELD QUALITY CONTROL

4.09 A. THE RIGHT IS RESERVED TO INVOKE THE FOLLOWING MATERIAL TESTING PROCEDURE AT ANY TIME, AND ANY NUMBER OF TIMES DURING PERIOD OF LINING APPLICATION.

4.10 B. THE OWNER WILL ENGAGE SERVICE OF AN INDEPENDENT TESTING LABORATORY TO SAMPLE MATERIALS BEING USED ON THE JOB SITE. SAMPLES OF MATERIAL WILL BE TAKEN, IDENTIFIED AND SEALED, AND CERTIFIED IN PRESENCE OF CONTRACTOR.

4.11 C. TESTING LABORATORY WILL PERFORM TESTS FOR ANY OF THE CHARACTERISTICS SPECIFIED, USING APPLICABLE TESTING PROCEDURES REFERENCED HEREIN, OR IF NONE ARE REFERENCED, IN MANUFACTURER'S PRODUCT DATA.

4.12 D. IF TEST RESULTS SHOW MATERIALS BEING USED DO NOT COMPLY WITH SPECIFIED REQUIREMENTS, CONTRACTOR MAY BE DIRECTED BY OWNER TO STOP WORK; REMOVE NON-COMPLYING MATERIALS; PAY FOR TESTING; REAPPLY LINING MATERIALS TO PROPERLY PREPARED SURFACES WHICH HAD PREVIOUSLY BEEN COATED WITH UNACCEPTABLE MATERIALS.

4.13 3.04 CURING, PROTECTION AND CLEANING

4.14 A. CURE RESINOUS LINING MATERIALS IN COMPLIANCE WITH MANUFACTURER'S DIRECTIONS, TAKING CARE TO PREVENT CONTAMINATION DURING STAGES OF APPLICATION AND PRIOR TO COMPLETION OF CURING PROCESS. CLOSE AREA OF APPLICATION FOR A MINIMUM OF 24 HOURS.

4.15 B. PROTECT RESINOUS LINING MATERIALS FROM DAMAGE AND WEAR DURING CONSTRUCTION OPERATION. WHERE TEMPORARY COVERING IS REQUIRED FOR THIS PURPOSE, COMPLY WITH MANUFACTURER'S RECOMMENDATIONS FOR PROTECTIVE MATERIALS AND METHOD OF APPLICATION. GENERAL CONTRACTOR IS RESPONSIBLE FOR PROTECTION AND CLEANING OF SURFACES AFTER FINAL COATS.

4.16 C. CLEANING: REMOVE TEMPORARY COVERING AND CLEAN RESINOUS LINING JUST PRIOR TO FINAL INSPECTION. USE CLEANING MATERIALS AND PROCEDURES RECOMMENDED BY RESINOUS LINING MANUFACTURER.

END OF SECTION

10/09/03

SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-suppression piping, fittings, and appurtenances.
2. Fire department connections.
3. System control valves.
4. Fire-suppression piping specialties.
5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gauges.

1.2 DEFINITIONS

A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of 175 psig maximum.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include construction details, material descriptions, dimensions of individual components and profiles.
b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Prepare in accordance with NFPA 13 section "Working Plans."

a. Include plans, elevations, and sections of the system piping and details.
b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.

c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Prepare computer-generated hydraulic calculations in accordance with the following:

a. Name of hydraulic program used.
b. Water supply information, including fire hydrant flow test data report.

3. Submit documents and calculations signed and sealed by qualified professional engineer responsible for their preparation.
4. Include diagrams for power, signal, and control wiring.

D. Delegated Design Submittals: For fire-suppression systems 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. Qualification Data: For qualified Installer and professional engineer.

B. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, including documented approval by AHJs, and including hydraulic calculations if applicable.

C. Welding certificates.

D. Field Test Reports:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
2. Fire-hydrant flow test report.

E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and

with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

2. System control valves.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Automatic wet-pipe sprinkler system.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-suppression system piping to withstand the effects of earthquake motions determined in accordance with NFPA 13 and ASCE/SEI 7. See Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

B. Fire-Suppression System Components, Devices, and Accessories: Listed in UL's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Fire-suppression system equipment, specialties, accessories, installation, and testing

to comply with NFPA 13.

E. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.

F. Delegated Design: Engage a qualified professional engineer to design fire-suppression systems.

1. Fire-Hydrant Flow Test:

a. Perform fire-hydrant flow test and record the following conditions:

1) Date: <Insert test date>.
2) Time: <Insert time>[a.m.][p.m.]
3) Performed by: <Insert operator's name> of <Insert firm>.
4) Location of Residual Fire Hydrant R: <Insert location>.
5) Location of Flow Fire Hydrant F: <Insert location>.
6) Static Pressure at Residual Fire Hydrant R: <Insert psig>.
7) Measured Flow at Flow Fire Hydrant F: <Insert gpm>.
8) Residual Pressure at Residual Fire Hydrant R: <Insert psig>.

b. Fire-hydrant flow test must be performed within previous 12 months prior to completion of design documents and hydraulic calculations.

2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
3. Sprinkler Occupancy Hazard Classifications:

a. Chlorine Storage Areas: Ordinary Hazard, Group 2.

4. Minimum Density for Automatic-Sprinkler Piping Design:

a. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500 sq. ft. area.

5. Maximum protection area per sprinkler in accordance with UL listing.
6. Total Combined Hose-Stream Demand Requirement: In accordance with NFPA 13 unless otherwise indicated:

a. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

G. Obtain documented approval of fire-suppression system design from AHJs.

2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

A. Steel Pipe, Fittings, and Appurtenances:

1. Schedule 40 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M,

or ASTM A795/A795M.

a. Standards:

1) UL 852.
2) FM 1630.

b. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
c. Pipe ends may be factory or field formed to match joining method.

2. Steel Pipe Nipples: black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
3. Steel Couplings: uncoated steel, ASTM A865/A865M, threaded.
4. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.

a. 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.

5. Plain-End-Pipe Fittings:

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) Gruvlok; an ASC Engineered Solution
2) Shurjoint; a part of Aalberts Integrated Piping Systems
3) Victaulic Company

b. Pressure Rating: 175 psig minimum.
c. Plain-End Fittings for Steel Piping: Painted plain-end fittings, ASTM A53/A53M, carbon steel or ASTM A106/A106M, forged steel with dimensions matching steel pipe.
d. Plain-End-Pipe Couplings for Steel Piping: Rigid pattern for steel-pipe dimensions, ductile-iron or malleable-iron housing. Include EPDM-rubber gasket, and bolts and nuts.

6. Grooved-Joint, Steel-Pipe Appurtenances:

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) CPS Products, Inc.
2) Gruvlok; an ASC Engineered Solution
3) Shurjoint; a part of Aalberts Integrated Piping Systems
4) Smith-Cooper International
5) SPF/Anvil; an ASC Engineered Solution

6) Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
7) Victaulic Company

b. Pressure Rating: 175 psig minimum.
c. Grooved-End Fittings for Steel Piping: Painted grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
d. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

B. Stainless Steel Pipe, Fittings, and Appurtenances:

1. Stainless Steel Pipe: ASTM A312/A312M, Type 316/316L, Schedule 10S, dimensions conforming to ASME B36.19M.
2. Stainless Steel Pipe Fittings: ASTM A403/A403M.
3. Fittings for Grooved-End, Stainless Steel Pipe:

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) GroovJoint

b. Source Limitations: Obtain appurtenance for grooved-end, stainless steel pipe from single manufacturer.
c. Fittings for Grooved-End, Stainless Steel Pipe: Stainless steel casting with dimensions matching stainless steel pipe.

4. Mechanical Couplings for Grooved-End, Stainless Steel Pipe:

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) GroovJoint

b. AWWA C606 for stainless steel pipe dimensions.
c. Stainless steel housing sections.
d. Stainless steel bolts and nuts.
e. EPDM-rubber gaskets suitable for hot and cold water.
f. Minimum Pressure Rating:

1) NPS 8 (DN 200) and Smaller: 600 psig.

2.4 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connection, Exposed Type:

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. Guardian Fire Equipment, Inc
    b. Potter Roemer LLC; a Division of Morris Group International
    c. Wilson & Cousins Inc.

2. Standard: UL 405.
3. Description: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two.
11. Escutcheon Plate Marking: "AUTO SPKR".
12. Finish: Rough brass or bronze.
13. Outlet Size: NPS 4 or NPS 6.

B. Fire Department Connection, Yard Type:

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. Guardian Fire Equipment, Inc
    b. Potter Roemer LLC; a Division of Morris Group International

2. Standard: UL 405.
3. Description: Exposed, freestanding.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Number of Inlets: Two.
11. Sleeve: Not required.
12. Escutcheon Plate Marking: "AUTO SPKR".

13. Finish, Including Sleeve: Rough brass or bronze.
14. Outlet Size: NPS 4 or NPS 6.

2.5 SYSTEM CONTROL VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Valves: 175 psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. System Control Valve, Alarm Valve:

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. Reliable Automatic Sprinkler Co., Inc. (The)
b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
c. Victaulic Company
d. Viking Group Inc.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, and fill-line attachment with strainer.
5. Drip cup assembly pipe drain with check valve to main drain piping.

2.6 FIRE-SUPPRESSION PIPING SPECIALTIES

A. Branch Outlet 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. Shurjoint; a part of Aalberts Integrated Piping Systems
b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America

c. Victaulic Company

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Sprinkler Inspector's Test 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. AGF Manufacturing, Inc.
b. Reliable Automatic Sprinkler Co., Inc. (The)
c. Viking Group Inc.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Manual Air Vent/Valve:

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. AGF Manufacturing, Inc.

2. Description: Ball valve that requires human intervention to vent air.
3. Body: Forged brass.
4. Ends: Threaded.
5. Minimize Size: 1/2 inch.
6. Minimum Water Working Pressure Rating: 300 psig.

2.7 SPRINKLERS

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. Reliable Automatic Sprinkler Co., Inc. (The)
2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
3. Victaulic Company
4. Viking Group Inc.

B. Standards:

1. UL 199.
2. UL 1626.
3. FM 2000.
4. FM 2008.
5. FM 2030.

C. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

D. Pressure Rating for Sprinklers:

1. Standard Automatic Sprinklers: 175 psig minimum.

E. Sprinklers, Automatic Wet with Heat-Responsive Element:

1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
2. Standard Spray, Standard Response:

   a. Upright.
   b. Pendent.

3. Standard Spray, Quick Response:

   a. Upright.
   b. Pendent.

4. Extended Coverage:

   a. Upright.
   b. Pendent.
   c. .

F. Sprinkler Finishes: bronze.

G. Special Coatings: corrosion-resistant paint.

H. Sprinkler Guards and Water Shields:

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. Reliable Automatic Sprinkler Co., Inc. (The)
b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
c. Victaulic Company
d. Viking Group Inc.

2. Standard: UL 199.
3. Description: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Match alarm-device material and connection types to piping and equipment materials and connection types.

B. Electrically Operated Notification Appliances:

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. Notifier; Honeywell International, Inc.
b. Potter Electric Signal Company, LLC

2. Electric Bell:

a. Standard: UL 464.
b. Type: Vibrating, metal alarm bell.
c. Size: 10-inch diameter.
d. Voltage: 120 V ac, 60 Hz, single phase.
e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.

3. Strobe/Horn:

a. Standard: UL 464.
b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
c. Voltage: 120 V ac, 60 Hz.
d. Effective Intensity: 110 cd.
e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
f. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and

instructing viewers to call 911, police or fire department.

C. Water-Flow Indicators:

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. Potter Electric Signal Company, LLC
    b. System Sensor; Honeywell International, Inc.
    c. Viking Group Inc.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125 V ac and 0.25 A, 24 V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

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. Kennedy Valve Company; a division of McWane, Inc.
    b. Potter Electric Signal Company, LLC
    c. System Sensor; Honeywell International, Inc.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Design: Signals that controlled valve is in other than fully open position.
5. Wire Terminal Designations: Indicates normal switch position when switch is properly installed on valve and valve is fully open.
6. 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.
7. OS&Y Valve Supervisory Switches:

    a. One or two single-pole, double-throw switches.
    b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
    c. Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.
    d. Mounting Hardware: Mounting bracket to grip valve yoke and prevent movement of switch assembly on OS&Y valve.

e. Trip Rod Length: Adjustable

8. Butterfly Valve Supervisory Switches:

   a. Two single-pole, double-throw switches.
   b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
   c. Mounting Hardware: Removable nipple.
   d. Trip Rod Length: Adjustable

9. Ball Valve Supervisory Switches:

   a. One single-pole, double-throw switch.
   b. NEMA Rating: NEMA 4 enclosure suitable for mounting in any position indoors or outdoors.
   c. Mounting Hardware: Suitable for mounting directly to pipe, ball valves, or backflow preventers sized from up to NPS 2.

E. Indicator-Post Supervisory Switches:

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. Potter Electric Signal Company, LLC
   b. System Sensor; Honeywell International, Inc.

2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.9 PRESSURE GAUGES

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. AGF Manufacturing, Inc.
2. Ametek U.S. Gauge
3. Ashcroft Inc
4. Brecco Corporation
5. WIKA Instrument Corporation

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gauge Range: 0 to 250 psig minimum.

E. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.

1. Flow test is to be performed to meet the criteria established by NFPA 13.
2. Flow test is to be conducted in accordance with NFPA 291.
3. Test is to be performed during a period of ordinary demand for the water system.

    a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.

4. Pitot readings are to be taken at the 2-1/2-inch orifice connection.
5. The pitot reading is to range from 10 to 35 psig.
6. Open additional hydrant outlets as needed to control pitot readings.
7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.

B. Flow Test Data Written Report:

1. Flow data report is to be written in accordance with NFPA 291.
2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.

C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.

D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.

E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF DOMESTIC WATER-SUPPLY CONNECTIONS

A. Connect fire-suppression water piping to building's interior domestic water-distribution piping.

B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-distribution piping.

3.3 INSTALLATION OF FIRE-SUPPRESSION PIPING

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from AHJs. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of fire-suppression piping.

C. Install seismic restraints on piping. Comply with NFPA standards requirements for seismic-restraint device materials and installation.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located in accordance with NFPA 13.

H. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and spill over floor drain or to exterior of building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards.

M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe/sprinkler supply. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.

N. Fill wet-type fire-suppression system piping with water.

O. Install sleeves for piping penetrations of walls, ceilings, and floors.

P. Install sleeve seals for piping penetrations of concrete walls and slabs.

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 INSTALLATION OF PIPING JOINTS

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.

M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

A. Install wall-type fire department connections.

B. Install yard-type fire department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."

C. Install three protective pipe bollards around each fire department connection.

D. Install automatic (ball-drip) drain valve at each check valve for fire department connection.

3.6 INSTALLATION OF VALVES AND SPECIALTIES

A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.

B. Install listed fire-suppression system shutoff valves in supervised open position, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. System Control Valves:

1. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
2. Install valves with trim sets for air supply, drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

D. Air Vent:

1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.

3.7 INSTALLATION OF SPRINKLERS

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect fire-suppression systems in accordance with NFPA standards.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Verify that equipment hose threads are same as local fire department equipment.
8. Verify that sprinklers original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.

C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.

D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.

E. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from fire-suppression system piping, system control valves,

sprinklers, and associated components.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers - FRP.
2. Fastener systems.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with 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 PIPE HANGERS - FRP

A. Pipe Hangers - FRP, Clevis Type:

1. Description: Similar to MSS SP-58, Type 1 factory-fabricated steel pipe hanger, except hanger is made of fiberglass-reinforced plastic resin.
2. Hanger Rods: Continuous-thread stainless steel rod, washer, and nuts made of FRP or stainless steel.
3. Flammability: ASTM D635, ASTM E84, UL 94.

B. Pipe Hangers - FRP, Strap Type:

1. Description: Similar to MSS SP-58, Type 9 or Type 10 steel pipe hanger, except hanger is made of fiberglass-reinforced plastic resin.

a. Flammability: ASTM D635, ASTM E84, UL 94.

2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.3 FASTENER SYSTEMS

A. Fastener System - Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements.

B. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements.
2. Indoor Applications: Stainless steel.
3. Outdoor Applications: Stainless steel.

2.4 MATERIALS

A. Aluminum: ASTM B221.

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, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. 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 is to include weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

B. Install lateral bracing with pipe hangers and supports to prevent swaying.

C. 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. Coordinate location of concrete inserts before concrete is placed.

D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

E. 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.

F. FRP Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions.
3. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
4. Install fasteners in accordance with manufacturer's written instructions.

H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

3.3 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.

3.4 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 FRP pipe hangers and stainless steel or corrosion-resistant attachments for hostile environment applications.

D. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
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 occurs.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs 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 occurs 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, in addition to expansion and contraction, is required.

E. 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.

F. 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 of 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.

G. 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.

H. 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.

I. 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.

J. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

K. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

L. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC pipe and fittings - domestic water.
2. Piping joining materials - domestic water.
3. Transition fittings - domestic water.

1.2 ACTION SUBMITTALS

A. Product Data:

1. PVC pipe and fittings - domestic water.
2. Piping joining materials - domestic water.
3. Transition fittings - domestic water.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.4 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service in accordance with requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and

NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372.

2.3 PVC PIPE AND FITTINGS - DOMESTIC WATER

A. PVC Pipe - Domestic Water: ASTM D1785, with wall thickness as indicated in "Piping Applications" Article.

1. Manufacturers: Subject to compliance with requirements.
2. Source Limitations: Obtain PVC pipe from single manufacturer.

B. PVC Socket Fittings: ASTM D2466 for Schedule 40 and ASTM D2467 for Schedule 80.

C. PVC Schedule 80 Threaded Fittings: ASTM D2464.

2.4 PIPING JOINING MATERIALS - DOMESTIC WATER

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 B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.

G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.

H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 TRANSITION FITTINGS - DOMESTIC WATER

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.

1. Manufacturers: Subject to compliance with requirements.
2. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.

D. Plastic-to-Metal Transition Fittings - Domestic Water:

1. Manufacturers: Subject to compliance with requirements.
2. Source Limitations: Obtain plastic-to-metal transition fittings from single source.
3. Description:

a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions - Domestic Water:

1. Manufacturers: Subject to compliance with requirements.
2. Source Limitations: Obtain plastic-to-metal transition unions from single manufacturer.
3. Description:

a. PVC four-part union.
b. Stainless steel threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller is to be the following:

1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
2. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

E. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:

1. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

3.2 INSTALLATION OF PIPING

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 domestic water piping level and plumb.

C. Install piping concealed from view and protected from physical contact by building occupants 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, and coordinate with other services occupying that space.

F. Install piping to permit valve servicing.

G. 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.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install sleeves for piping penetrations of walls, ceilings, and floors.

K. Install sleeve seals for piping penetrations of concrete walls and slabs.

L. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join in accordance with ASTM D2846/D2846M.
3. PVC Piping: Join in accordance with ASTM D2855.

E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or][unions.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install vinyl-coated hangers for PVC pipe, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping within 12 inches of each fitting.

D. Support vertical runs of PVC pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 PIPING 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. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

3.7 IDENTIFICATION

A. Identify system components.

3.8 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 in accordance with 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.

3.9 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.

3.10 FIELD QUALITY CONTROL

A. 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 installation 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. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    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. Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
    f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 221116

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC pipe and fittings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. PVC pipe and fittings.

1.3 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10 ft. head of water.
2. Waste, Force-Main Piping: 100 psig.

2.2 PIPING MATERIALS

A. Piping materials to 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.

2.3 PVC PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements.

B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.

C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F656.

F. Solvent Cement: ASTM D2564.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements.
    b. Standard: ASTM C1173.
    c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. End Connections: Same size as and compatible with pipes to be joined.
    e. Sleeve Materials:

        1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
        2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
        3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements.
b. Standard: ASTM C1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.

5. Pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements.
b. Standard: AWWA C219.
c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: [Manufacturer's standard][Carbon steel][Stainless steel][Ductile iron][Malleable iron].
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements.
b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements.
b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 125 psig minimum at 180 deg F.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements.
b. Description:

1) Nonconducting 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.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements.
b. Description:

1) Standard: IAPMO PS 66.
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

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 drain pipe.

    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 Waste Piping: Two percent downward in direction of flow.
2. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.

M. Install aboveground PVC piping in accordance with ASTM D2665.

N. Install underground [PVC piping in accordance with ASTM D2321.

O. Install force mains at elevations indicated.

P. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

    a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.

2. Install drains in sanitary waste gravity-flow piping.

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors.

S. Install sleeve seals for piping penetrations of concrete walls and slabs.

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Grooved Joints: Cut groove ends of pipe in accordance with 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.

B. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

D. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:

    a. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Unshielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

    a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
    b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF VALVES

A. General valve installation requirements for general-duty valve installation are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install full-port ball valve for piping NPS 2 and smaller.
3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".

1. Install fiberglass pipe hangers for horizontal piping in corrosive environments.
2. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42 clamps.

B. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

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.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections in accordance with 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.

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 in accordance with 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 ft. 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.

E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

   a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

   a. Isolate test source and allow to stand for four hours.
   b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 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 Plastic Piping: Protect PVC 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 and waste piping NPS 4 (DN 100) and smaller are to be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, vent piping NPS 4 (DN 100) is to be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

SECTION 22 14 14 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC pipe and fittings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. PVC pipe and fittings.

1.3 QUALITY ASSURANCE

A. Provide materials bearing label, stamp, or other markings of specified testing agency.

1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are to be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

2.2 PIPING MATERIALS

A. Piping materials to 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.

2.3 PVC PIPE AND FITTINGS

A. PVC Pipe:

1. Manufacturers: Subject to compliance with requirements.
2. NSF Marking: Comply with NSF 14 for plastic piping components. Include marking with "NSF-dwv" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.
3. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

B. PVC Socket Fittings:

1. Manufacturers: Subject to compliance with requirements.
2. Standard: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
3. NSF Marking: Comply with NSF 14 for plastic piping components. Include marking with "NSF-dwv" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. Adhesive Primer: ASTM F656.

D. Solvent Cement: ASTM D2564.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Shielded, Nonpressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements.
    b. Standard: ASTM C1460.
    c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

B. Install piping as indicated unless deviations from layout are approved on coordination drawings.

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.

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. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.

1. Do not change direction of flow more than 90 degrees.
2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of drainage piping in direction of flow is prohibited.

I. Install piping at the following minimum slopes unless otherwise indicated.

1. Horizontal Storm Drainage Piping: 1/8 inch per foot downward in direction of flow.

J. Install aboveground PVC piping in accordance with ASTM D2665.

K. Plumbing Specialties:

1. Install cleanouts in storm drainage gravity-flow piping in accessible locations.
2. Install drains in storm drainage gravity-flow piping.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

M. Install sleeves for piping penetrations of walls, ceilings, and floors.

N. Install sleeve seals for piping penetrations of concrete walls and slabs.

O. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

A. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendices.

B. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:

    a. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.

3.3 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install fiberglass pipe hangers for horizontal piping in corrosive environments.
2. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping and tubing within 12 inches of each fitting[, valve,] and coupling.

D. Support vertical PVC piping with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping.

3.7 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.
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 storm drainage piping in accordance with 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 storm drainage piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

3. Test Procedure:

a. Test storm drainage piping[, except outside leaders,] on completion of roughing-in.
b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
c. From 15 minutes before inspection starts until completion of inspection, water level must not drop.
d. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

3.9 PROTECTION

A. Protect piping and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day and when work stops.

C. Repair damage to adjacent materials caused by storm drainage piping installation.

3.10 PIPING SCHEDULE

A. Aboveground storm drainage piping NPS 6 and smaller is to be[any of] the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 14 14

SECTION 22 45 00 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Combination units.

1.2 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ISEA Standard: Comply with ISEA Z358.1.

C. NSF Standard: Comply with NSF 61 and NSF 372, for fixture materials that will be in contact with potable water.

2.2 COMBINATION UNITS

A. Standard, Plumbed Emergency Shower with Eye/Face Wash Combination Units.

1. Piping:

    a. Material: PVC.
    b. Unit Supply: NPS 1-1/4 inimum.
    c. Unit Drain: Outlet at back or side near bottom.

2. 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, stainless steel or plastic.
    e. Mounting: Pedestal.

3. Eye/Face Wash Unit:

    a. Capacity: Not less than 3.0 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: Stainless-steel or plastic bowl.
    f. Mounting: Attached shower pedestal.

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 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of the equipment. Use ball or gate valve if specific type valve is not indicated. Install valves

chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation.

1. 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.

3.3 CONNECTIONS

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."

B. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment.

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

END OF SECTION 224500

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:

a. Constant-volume air systems.
b. Dual-duct systems.
c. Variable-air-volume systems.
d. Multizone systems.
e. Induction-unit systems.

2. Testing, adjusting, and balancing of equipment.
3. Vibration tests.
4. Duct leakage tests verification.
5. Pipe leakage tests verification.
6. HVAC-control system verification.

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.

G. UFAD: Underfloor air distribution.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB reports.

C. Sample report forms.

D. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.4 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Applicable)
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data, including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use

tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine 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.

I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

J. Examine system pumps to ensure absence of entrained air in the suction piping.

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 the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.

B. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Fans and ventilators.
3. Split-system air conditioners.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' Record drawings duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. 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.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.7 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of compressor(s), fan(s), and motors.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Entering and leaving refrigerant pressure and temperatures.

3.9 DUCT LEAKAGE TESTS

A. Witness the duct leakage testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.10 PIPE LEAKAGE TESTS

A. Witness the pipe pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.11 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.12 TOLERANCES

A. Set HVAC system's airflow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent or minus 5 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.13 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. 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. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans performance forms, including the following:

    a. Cooling coil, wet- and dry-bulb conditions.
    b. Heating coil, dry-bulb conditions.
    c. Fan drive settings, including settings and percentage of maximum pitch diameter.
    d. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Duct, outlet, and inlet sizes.
2. Balancing stations.
3. Position of balancing devices.

E. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.

b. Location.
c. Coil type.
d. Fin spacing in fins per inch o.c.
e. Make and model number.
f. Face area in sq. ft..
g. Tube and fin materials.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Refrigerant expansion valve and refrigerant types.
i. Refrigerant suction pressure in psig.
j. Refrigerant suction temperature in deg F.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and speed.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Discharge static pressure in inches wg.

e. Suction static pressure in inches wg.

G. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.14 VERIFICATION OF TAB REPORT

A. Prepare test and inspection reports. Submit report to engineer for approval.

END OF SECTION 230593

SECTION 233116 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoset FRP ducts and fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Thermoset FRP duct materials.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevation of top of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Equipment installation based on equipment being used on Project.
9. Hangers and supports, including methods for duct and building attachment and vibration isolation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

1. Static-Pressure Classes:

a. Exhaust Ducts (Negative Pressure): 1-inch wg.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1, Section 5.4 - "Airstream Surfaces."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

E. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

2.2 THERMOSET FRP DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements.

B. Duct and Fittings:

1. Thermoset FRP Resin: Comply with UL 181, Class 1, maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL according to ASTM E84.
2. Inner Liner: FSK liner rated by an NRTL to comply with UL 181, Class 1.
3. Round Duct: ASTM D2996, Type I, Grade 2, Class E, filament-wound duct, minimum 0.125-inch wall thickness, with tapered bell-and-spigot ends for adhesive joints or with plain ends with couplings.
4. Round Fittings: Compression or spray-up/contact, molded of same material, pressure class, and joining method as duct.
5. Rectangular Fittings: Minimum 0.125-inch-thick, flat sheet with fiberglass roving and resin-reinforced joints and seams.

C. Joining Materials: Roving and polyester resin.

D. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, and access doors and panels according to SMACNA's "Thermoset FRP Duct Construction Manual," Ch. 7, "Requirements."
2. Fabricate 90-degree rectangular mitered elbows to include turning vanes, and 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.

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

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: ASTM A492, stainless-steel cables with end connections made of stainless-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.

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 duct sections in maximum practical lengths with fewest possible joints.

C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

D. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Install ducts with a minimum clearance of 1 inch, plus allowance for insulation thickness.

G. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

H. 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. Overlap openings on four sides by at least 1-1/2 inches.

I. Install fire[, combination fire/smoke,] and smoke dampers where indicated on Drawings and as required by code and by authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the fire damper UL listing.

J. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.

L. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes, and 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.

M. Branch Connections: Use lateral or conical branch connections.

N. Install thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual."

3.2 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports for thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual," Ch. 7, "Requirements."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 STARTUP SERVICE

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

SECTION 233400 - HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fans, utility set.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
b. Rated capacities, furnished specialties, and accessories for each fan.
c. Fans:

1) Certified fan performance curves with system operating conditions indicated.
2) Certified fan sound-power ratings.
3) Fan construction and accessories.
4) Motor ratings and electrical characteristics, plus motor and electrical accessories.
5) Fan speed controllers.

d. Material thickness and finishes, including color charts.
e. Dampers, including housings, linkages, and operators.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.
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.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fans and ventilators, include the following:

1. Operation in normal and emergency modes.
2. Operation and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective coverage for storage and identified with labels describing contents.

1. Belts: Two set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. Capacities and Characteristics:

1. Refer to equipment schedule on plans.

D. Service Conditions:

1. Ambient Temperature: 115 deg F.
2. Altitude: 1,000 feet above sea level.
3. Humidity: 70 deg F wet bulb.

2.2 FANS, UTILITY SET

A. Manufacturers: Subject to compliance with requirements.

B. Source Limitations: Obtain fan utility sets from single manufacturers.

C. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fan utility vent sets, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

D. Housings:

1. Housing Material: Aluminum.
2. Housing Coating: See schedule.
3. Formed panels to make curved-scroll housings with shaped cutoff.
4. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
5. Discharge Arrangement: Fan scroll housing field rotatable to any of seven discharge positions. Provide fan with discharge positioned in proper direction to minimize connected duct turns.

E. Wheels:

1. Wheel Configuration: SWSI, with hub keyed to shaft.
2. Wheel and Blade Materials: Aluminum.
3. Backward-Inclined Airfoil Blades:

    a. Aerodynamic design.
    b. Heavy backplate.
    c. Hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate.

4. Backward-Inclined Curved Blades:

    a. Curved design.
    b. Heavy backplate.
    c. Single-thickness blades continuously welded at tip flange and backplate.

F. Shafts:

1. Turned, ground, and polished steel; keyed to wheel hub. First critical speed at least 1.4 times maximum class speed.

G. Bearings:

1. Heavy-duty regreasable ball or roller type in a cast-iron pillowblock housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 of 80,000 hours.
3. Extend grease fitting to accessible location outside of unit.

H. Belt Drive:

1. Factory mounted, with final alignment and belt adjustment made after installation.
2. Service Factor Based on Fan Motor Size: 1.5.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Comply with OSHA and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," 0.146-inch-thick, 3/4-inch diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short-circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

I. Motor Enclosure: Open, dripproof.

J. Accessories:

1. Inlet and Outlet: Flanged.

2. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades, with felt edges in steel frame installed on fan discharge.
3. Access Door: Gasketed door in scroll with latch-type handles.
4. Belt Guard: OSHA-compliant, fabricated in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Diamond mesh wire screen welded to steel angle frame or equivalent, prime coated.
5. Drain Connections: NPS 1-inch threaded coupling drain connection installed at lowest point of housing.
6. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."

B. Where variable-frequency drives are indicated or scheduled, provide fan motor compatible with variable-frequency drive.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, in accordance with manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:

1. Install roof-mounted fans on roof curbs or support steel. See Drawings for specific requirements.

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2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Curb Support, Prefabricated: Rail-type wood support provided by fan manufacturer.

F. Isolation Curb Support: Install centrifugal fans on isolation curbs, and install flexible duct connectors and vibration-isolation devices.

1. Comply with requirements in Section 230548.13 "Vibration Controls for HVAC."

G. Install units with adequate clearances for service and maintenance.

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Where installing ducts adjacent to fans, allow space for service and maintenance.

3.3 PIPING CONNECTIONS

A. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, with pipe sizes matching the drain connection. Refer to plan for routing.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.6 STARTUP SERVICE:

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.

6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

3.7 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

D. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.8 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties.
3. Fans and components will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain HVAC fans.

END OF SECTION 233400

SECTION 233723 - 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

1.3 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. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

B. Capacities and Characteristics:

1. Refer to drawings for schedule.

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 air.

B. Manufacturers: Subject to compliance with requirements.

C. Source Limitations: Obtain hooded ventilators from single manufacturer.

D. Construction:

1. Material, Aluminum: 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. Bird Screening: Aluminum, 1/2-inch- square mesh or flattened, expanded aluminum, 3/4-inch diamond mesh wire.

E. Dampers:

1. Location: Curb damper tray.
2. Control: Gravity backdraft.
3. Tray: Provide damper tray or shelf with opening 3 inches less than interior curb dimensions indicated.

F. 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. Overall Height: 12 inches.

2.4 SOURCE QUALITY CONTROL

A. AMCA Certification for Hooded Ventilators: Test, rate, and label gravity ventilators in accordance with AMCA 511.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A653/A653M, G90 zinc coating, mill phosphatized.

D. Stainless Steel Sheet: ASTM A666, Type 304, with No. [4][6] 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 [Phillips flat][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 E488/E488M, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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. Refer to Section 077200 "Roof Accessories."

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.

F. 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.

G. 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 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Split-system air-conditioners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

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: One year(s) from date of Substantial Completion.
    c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SPLIT-SYSTEM AIR-CONDITIONERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Trane

B. Indoor, Exposed, Wall-Mounted Units

1. Description: Factory-assembled[and -tested] complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

2. Cabinet:

    a. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
    b. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
    c. Mounting: Manufacturer-designed provisions for field installation.
    d. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

3. DX Coil Assembly:

    a. Coil Casing: Aluminum, galvanized, or stainless steel.
    b. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
    c. Coil Tubes: Copper, of diameter and thickness required by performance.
    d. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
    e. Unit Internal Tubing: Copper tubing with brazed joints.
    f. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
    g. Field Piping Connections: Manufacturer's standard.
    h. Factory Charge: Dehydrated air or nitrogen.
    i. Testing: Factory pressure tested and verified to be without leaks.

4. Drain Assembly:

    a. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
    b. Condensate Removal: Gravity.
    c. Field Piping Connection: Non-ferrous material.

5. Fan and Motor Assembly:

    a. Fan(s):

        1) Direct-drive arrangement.
        2) Single or multiple fans connected to a common motor shaft and driven by a single motor.
        3) Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
        4) Wheels statically and dynamically balanced.

    b. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
    c. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
    d. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
    e. Vibration Control: Integral isolation to dampen vibration transmission.

6. Filter Assembly:

    a. Access: Front, to accommodate filter replacement without the need for tools.
    b. Washable Media: Manufacturer's standard filter with antimicrobial treatment.

7. Grille Assembly: Manufacturer's standard discharge grille with field-adjustable air pattern mounted in top or front face of unit cabinet.
8. Unit Controls:

    a. Enclosure: Manufacturer's standard, and suitable for indoor locations.
    b. Factory-Installed Controller: Configurable digital control.
    c. Communication: Network communication with other indoor units and outdoor unit(s).
    d. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
    e. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

9. Unit Electrical:

    a. Enclosure: Manufacturer's standard, and suitable for indoor locations.
    b. Field Connection: Single point connection to power entire unit and integral

controls.

c. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
d. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
e. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
f. Raceways: Enclose line voltage wiring in [metal]raceways to comply with NFPA 70.

C. Outdoor, Ai-Source Heat-Pump Units:

1. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

a. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
b. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
c. All units installed shall be from the same product development generation.

2. Cabinet:

a. Galvanized steel and coated with a corrosion-resistant finish.
b. Mounting: Manufacturer-designed provisions for field installation.
c. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

3. Compressor and Motor Assembly:

a. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
b. Protection: Integral protection against the following:

1) High refrigerant pressure.
2) Low oil level.
3) High oil temperature.
4) Thermal and overload.
5) Voltage fluctuations.
6) Phase failure and phase reversal.
7) Short cycling.

c. Speed Control: Variable to automatically maintain refrigerant suction and

condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.

d. Vibration Control: Integral isolation to dampen vibration transmission.
e. Oil management system to ensure safe and proper lubrication over entire operating range.
f. Crankcase heaters with integral control to maintain safe operating temperature.
g. Fusible plug.

4. Condenser Coil Assembly:

   a. Plate Fin Coils:

      1) Casing: Aluminum, galvanized, or stainless steel.
      2) Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
      3) Tubes: Copper, of diameter and thickness required by performance.

   b. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

5. Condenser Fan and Motor Assembly:

   a. Fan(s): Propeller type.

      1) Direct-drive arrangement.
      2) Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
      3) Statically and dynamically balanced.

   b. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
   c. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
   d. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
   e. Speed Settings and Control: Variable speed with a speed range of least 75percent.
   f. Vibration Control: Integral isolation to dampen vibration transmission.

6. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
7. Unit Controls:

   a. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
   b. Factory-Installed Controller: Configurable digital control.

8. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse

protection.

9. Communication: Network communication with indoor units and other outdoor unit(s).
10. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
11. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
12. Unit Electrical:

    a. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
    b. Field Connection: Single point connection to power entire unit and integral controls.
    c. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
    d. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
    e. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
    f. Raceways: Enclose line voltage wiring in [metal]raceways to comply with NFPA 70.

13. Unit Hardware: Zinc-plated steel, or stainless steel.
14. Unit Piping:

    a. Unit Tubing: Copper tubing with brazed joints.
    b. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
    c. Field Piping Connections: Manufacturer's standard.
    d. Factory Charge: Dehydrated air or nitrogen.
    e. Testing: Factory pressure tested and verified to be without leaks.

D. Capacities and Characteristics: Refer to drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF SPLIT-SYSTEM AIR-CONDITIONERS

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).

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings.

Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

26 00 10 General Provisions

PART 1 – GENERAL

1.01 GENERAL CONDITIONS

A. The General Conditions and Requirements, Special Provisions, are hereby made a part of this Section.

B. The Electrical Drawings and Specifications under this Section shall be made a part of the Contract Documents. The Drawings and Specifications of other sections of this contract, as well as supplements issued thereto, information to bidders and pertinent documents issued by the Owner's Representative are a part of these Drawings and Specifications and shall be complied with in every respect. All the above documents will be on file at the office of the Owner's representative and shall be examined by all the bidders. Failure to examine all documents shall not relieve the responsibility or be used as a basis for additional compensation.

C. Furnish all work, labor, tools, superintendence, material, equipment and operations necessary to provide for a complete and workable electrical system as defined by the Contract Documents. A licensed journeyman shall be on site at all times while electrical work is being performed and a licensed master electrician shall be in charge of the work. Submit license for master electrician and all journeymen.

D. Be responsible for visiting the site and checking the existing conditions. Ascertain the conditions to be met for installing the work and adjust bid accordingly. This project shall include electrical work as shown on the Location Map.

E. It is the intent of the Contract Documents that upon completion of the electrical work, the entire system shall be in a finished, workable condition.

F. All work that may be called for in the Specifications but not shown on the Drawings, or, all work that may be shown on the Drawings but not called for in the Specifications, shall be performed by the Contractor as if described in both. Should work be required which is not set forth in either document, but which work is nevertheless required for fulfilling of the intent thereof, then the Contractor shall perform all work as fully as if it were specifically set forth in the Contract Documents.

G. The definition of terms used throughout the Contract Documents shall be as specified by the following agencies:

1. Underwriters Laboratories
2. National Electrical Manufacturers Association
3. American National Standards Institute
4. Insulated Power Cable Engineers Association
5. National Electrical Code
6. National Fire Protection Association

H. The use of the terms "as (or where) indicated", "as (or where) shown", "as (or where) specified", or "as (or where) scheduled" shall be taken to mean that the reference is made to the Contract Documents, either on the Drawings or in the Specifications, or both documents.

I. The use of the words "furnish", "provide", or "install" shall be taken to mean that the item or facility is to be both furnished and installed under Division 26, unless stated to the contrary that the item or facility is to be either furnished under another Division or under another Contract, furnished under this Division and installed under another Division or under another Contract, or furnished and installed under another Division or under another Contract.

1.02 PERMITS AND CODES

A. Secure all permits, licenses, and inspection as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, rules, regulations and contract requirements bearing on the work.

B. The minimum requirements of the electrical system installation shall conform to the latest edition of the National Electrical Code, as well as state and local codes.

C. Codes and ordinances having jurisdiction and specified codes shall serve as minimum requirements, but, if the Contract Documents indicate requirements which are in excess of those minimum requirements, then the requirements of the Contract Documents shall be followed. Should there be any conflicts between the Contract Documents and codes, or any ordinances, report these with bid.

PART 2 - PRODUCTS

2.01 STANDARDS

A. All materials and equipment shall conform to the requirements of the Contract Documents. They shall be new, free from defects, and they shall conform to the following standards where these organizations have set standards:

1. Underwriters Laboratories (UL)
2. National Electrical Manufacturer's Association (NEMA)
3. American National Standards Association (ANSI)
4. Insulated Cable Engineers Association (ICEA)

B. All material and equipment of the same class shall be supplied by the same manufacturer, unless specified to the contrary.

C. All products shall bear UL labels where standards have been set for listing. All other products shall be UL labeled. Motor control centers, switchboards, and switchgear shall have UL labels. Custom panels, modified motor starters, control panels, and instrument panels and the like shall be manufactured by a fabricator approved as a UL508A shop and shall bear a UL 508A or UL Industrial Control Panel label.

D. When the Contractor provides a product for this project he shall be bound by the terms and conditions of the Contract Documents and he shall agree to warrant and to be liable for the merchantability and fitness of his product to the applications to which his product is applied under the Contract Documents.

2.02 SHOP DRAWINGS AND SUBMITTALS

A. Shop drawings and submittals shall comply with general conditions and as specified herein.

B. Shop drawings shall be taken to mean detailed drawings with dimensions, schedules, weights, capacities, installation details and pertinent information that will be needed to describe the material or equipment in detail.

C. Submittals shall be taken to mean catalog cuts, general descriptive information, catalog numbers and manufacturer's name.

D. Submit for review all shop drawings and submittals as hereinbefore called for.

E. Review of submittals or shop drawings shall not remove the responsibility for furnishing materials or equipment or proper dimensions, quantity and quality, nor will such review remove the responsibility for error in the shop drawings or submittals.

F. Failure to process submittals or shop drawings on any item and/or items specified shall make the Contractor responsible for the suitability for the item and/or items, even though the item and/or items installed appear to comply with the Contract Documents.

G. Assume all costs and liabilities which may result from the ordering of any material or equipment prior to the review of the shop drawings or submittals, and no work shall be done until the shop drawings or submittals have been reviewed. In case of correction or rejection, resubmit until such time as they are accepted by the Owner's Representative, and such procedures will not be cause for delay.

H. Submittals and shop drawings shall be compiled from the manufacturer's latest product data. Should there be any conflicts between this data and the Contract Documents, report this information for each submittal and/or shop drawing.

I. Shop drawings and submittals will be returned and unchecked if the specific items proposed are not clearly marked, or if the General Contractor's approval stamp is omitted.

J. When requested, furnish samples of materials for acceptance review. If a sample has been reviewed and accepted, then that item of material or equipment installed on the job shall be equal to the sample; if it is found that the installed item is not equal, then replace all such items with the accepted sample equivalent.

2.03 ACCEPTANCE AND SUBSTITUTIONS

A. All manufacturers named are a basis as a standard of quality and substitutions of any equal product will be considered for acceptance. The judgment of equality of product substitution shall be made by the Engineer.

B. Substitutions after award of Contract shall be made only within sixty (60) days after the notice to proceed. Furnish all required supporting data. The submittal of substitutions for review shall not be cause for time extensions.

C. Where substitutions are offered, the substituted product shall meet the product performance as set forth in the specified manufacturer's current catalog literature, as well as meeting the details of the Contract Documents.

D. The details on the drawings and the requirements of the Specifications are based on the first listed material or equipment. If any other than the first listed material or equipment is furnished, then assume responsibility for the correct function, operation, and accommodation of the substituted item. In the event of misfits or changes in work required, either in this section or other sections of the Contract, or in both, bear all costs in connection with all changes arising out of the use of other than the first listed item specified.

E. Substitutions of products under other sections may occur. Make necessary adjustments and additions to work under Division 26 to accommodate those substitutions. Such adjustments and additions shall be performed in compliance with Division 26 Specifications at no additional charge.

F. Energy efficiency of each item of power consuming equipment shall be considered one of the standards for evaluation.

PART 3 - EXECUTION

3.01 CUTTING AND PATCHING

A. Cutting and patching required under this section shall be done in a neat workmanlike manner. Cutting lines shall be uniform and smooth.

B. Use concrete saws for large cuts in concrete and use core drills for small round cuts in concrete.

C. Where openings are cut through masonry walls, provide lintel or other structural support to protect the remaining masonry. Adequate support shall be provided during the cutting operation to prevent damage to masonry.

D. Where large openings are cut through metal surfaces, attach metal angle around the opening.

E. Patch concrete openings that are to be filled with nonshrinking cementing compound. Finish concrete patching shall be troweled smooth and shall be uniform with surrounding surfaces.

3.02 WATERPROOFING

Provide waterproof flashing for each penetration of exterior walls and roofs.

3.03 CONSTRUCTION REQUIREMENTS

A. Except where specifically noted or shown, the locations and elevations of equipment are approximate and are subject to small revisions as may prove necessary or desirable at the time the work is installed. Locations changed substantially from that shown on the drawings shall be confirmed with the Engineer in advance of construction.

B. Where equipment is being furnished under another Division, request from Engineer an accepted drawing that will show exact dimensions of required locations or connections. Install the required facilities to the exact requirements of the accepted drawings.

C. All work shall be done in the best and most workmanlike manner by qualified, careful electricians who are skilled in their trade. The standards of work required throughout shall be of the first class only.

D. Unless shown in detail, the Drawings are diagrammatic and do not necessarily give exact details as to elevations and routing of raceways, nor do they show all offsets and fittings; nevertheless, install the raceway system to conform to the structural and mechanical conditions of the construction.

E. Holes for raceway penetration into sheet metal cabinets and boxes shall be accurately made with an approved tool. Cutting openings with a torch or other device that produces a jagged, rough cut will not be acceptable.

F. Cabling inside equipment shall be carefully routed, trained and laced. Cables so placed that they obstruct equipment devices will not be acceptable.

G. Equipment shall be set level and plumb. Supporting devices installed shall be set and so braced that equipment is held in a rigid, tight-fitting manner.

3.04 EQUIPMENT PROTECTION

A. Provide suitable protection for all equipment, work and property against damage during construction.

B. Assume full responsibility for material and equipment stored at the site.

C. Conduit openings shall be closed with caps or plugs during installation and made watertight. All outlet boxes and cabinets shall be kept free of concrete, plaster, dirt and debris.

D. Equipment shall be covered and tightly sealed against entrance of dust, dirt and moisture.

E. All dry-type transformers prior to energization shall be protected against moisture and dirt absorption by a suitable covering. Also, maintain heat inside the covering by means of 100 watt minimum lamps.

3.05 COOPERATION WITH WORK UNDER OTHER DIVISIONS

A. Cooperate with all other trades so as to facilitate the general progress of their work. Allow all other trades every reasonable opportunity for the installation of their work and the storage of their materials.

B. The work under this section shall follow the general building construction closely. Set all pipe sleeves, inserts, etc., and see that openings for chases, pipes, etc.., are provided before concrete is placed or masonry installed.

C. Work with other trades in determining exact locations of outlets, conduits, fixtures, and pieces of equipment to avoid interference with lines as required to maintain proper installation of other work.

D. Make such progress in work that will not delay the work of other trades. Schedule the work so that completion dates as established by the Engineer are met. Furnish sufficient labor or work overtime to accomplish these requirements if directed to do so.

3.06 INSTALLATION OF WORK UNDER ANOTHER DIVISION

A. Verify the electrical capacities of all motors and electrical equipment furnished under other sections, or furnished by the Owner, and request wiring information from the Engineer if wiring requirements are different from that specified under this Section. Do not make rough-ins until equipment verification has been received.

B. Install all motors, controllers, terminal boxes, pilot devices, and miscellaneous items of electrical equipment that are not integrally mounted with the equipment furnished under other divisions. All such equipment shall be securely mounted and adequately supported in a neat and workmanlike manner.

3.07 CLEAN-UP

A. Remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work, clean equipment and the entire installation so as to present a first class job suitable for occupancy. No loose parts or scraps of equipment shall be left on the premises.

B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer or with an approved paint.

C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt and debris.

3.08 TESTS

A. Test all systems furnished under Division 26 and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of the system.

B. Make all circuit breaker and protective relay adjustments and settings.

C. Make the following minimum tests and checks prior to energizing the electrical equipment:

1. Check all wire and cable terminations for tightness.
2. Test all wiring as specified in Section 26 01 20.
3. Test grounding system as specified in Section 26 04 50.
4. Set all transformer taps as required to obtain the proper secondary voltage.
5. Carefully check all interlocking, control and instrument wiring for each system to ascertain that the system will function properly as indicated by schematics, wiring diagrams, or as specified herein.
6. Mechanical inspection of all low voltage circuit breakers, disconnect switches, motor starters, control equipment, etc. for proper operation.
7. Provide all instruments and equipment required for the above tests.

3.09 RECORD DRAWINGS

A. At the start and during the progress of the job, keep one separate set of blue-line prints for making construction notes and mark-ups.

B. Show conduit routing and wiring runs as constructed and identify each.

C. Record all deviations from the Contract Documents.

D. Submit set of marked-up drawings for review. The final payment will not be made until the review is complete.

3.11 OPERATIONS AND MAINTENANCE MANUALS

A. Compile an Operations and Maintenance Manual on each item of equipment. These manuals shall include detailed instructions and maintenance as well as spare parts lists.

B. Submit copies for review as hereinbefore specified.

C. Preliminary Operations and Maintenance Manuals shall be included with the initial shipments.

END OF SECTION

No specifications on this page for formatting purposes.

26 01 10 Raceways

PART 1 - GENERAL

1.01 SCOPE

A. This section shall include raceways, enclosures, supporting devices ancillary fittings and appurtenances. Furnish and install the complete raceway systems as shown on the Drawings and as specified herein.

B. Raceway is a broad-scope term that shall be defined by the National Electrical Code under Article 100.

1.02 APPLICATIONS

A. Except as otherwise shown on the Drawings, or otherwise specified, all underground and in-slab conduit raceways shall be shall be made with schedule 40 PVC. Bends to grade shall be made with plastic coated rigid galvanized steel conduit.

B. Except as otherwise shown on the Drawings, or otherwise specified, all outdoor exposed power, control, and instrumentation, signal, and communication conduit shall be PVC Coated rigid steel conduit. The inside of the chlorine storage building shall be a NEMA 4X corrosive area. In those area furnish plastic coated rigid steel conduit, fittings, and boxes.

1.03 SUBMITTALS AND SHOP DRAWINGS

A. Process catalog submittals for the following:

1. Plastic Jacketed Rigid Steel Conduit
2. Rigid Non-Metallic Conduit
3. Liquid-tight Flexible Conduit
4. Liquid-tight Fittings
5. Conduit Bushings
6. Conduit Bodies
7. Conduit Sealing Fittings
8. Expansion-Deflection Fittings
9. Expansion Fittings
10. Cast Metal Boxes
11. NEMA 4X J-Boxes
12. Tape Products
13. Wiring Devices
14. Supporting Devices
15. Labels
16. Grounding Devices
17. Foam Sealant
18. Conduit End Bell Fittings

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Plastic coated rigid steel conduit shall consist of rigid steel body that complies with above specifications for rigid metallic steel conduit, plus conduit shall have 40 mil thick heat-fused PVC over outside and 2 mil coat of fully catalyzed phenolic inside. The inside coat shall have the chemical resistance of the outer coating and shall not dissolve in lacquer thinner. All couplings

shall be equipped with PVC sleeves that extend one pipe diameter or 2", whichever is less, beyond the end of the coupling. All plastic coated conduit shall conform to NEMA Standard #RNI-1974 (Type A) and such conduit shall be Robroy "Plastibond Red", or equal.

B. Non-metallic rigid conduit shall be Schedule 40 PVC. Such conduit shall be UL listed for 90 degrees C and shall conform to NEMA TC-2 and UL-651 standards. Furnish Carlon, Cantex, or equal. Furnish manufacturer's approved solvent for joining couplings.

C. Liquid-tight flexible conduit shall consist of hot-dipped galvanized, flexible interlocking steel core with thermoplastic cover, integral copper ground wire (through 1-1/4" trade size) and shall be Anaconda Sealtite or equal.

2.02 CONDUIT FITTINGS

A. NEMA 4 locknuts for rigid metallic conduit shall consist of galvanized steel body with neoprene sealing ring. Furnish Crouse-Hinds, T&B, or equal.

B. NEMA 1 locknuts for rigid metallic conduits shall be galvanized steel for use with galvanized steel conduit and hardened aluminum for use with aluminum conduit.

C. Conduit field-applied hubs for sheet metal enclosures shall be aluminum body with recessed neoprene sealing ring, threaded NPT insert, and shall be, T&B 370 AL series, or equal products by OZ/Gedney.

D. Conduit hubs for non-metallic enclosures shall be fiberglass polyester reinforced with galvanized steel core, complete with locknut and grounding bushing. All such hubs shall be Crouse-Hinds Type NHU, or equal.

E. Rigid metallic conduit chase nipples, split couplings, slip fittings, unions, reducers, and enlargers, shall be hot-dip or mechanically galvanized malleable iron.

F. Rigid metallic conduit short els and long els shall be hot-dip galvanized malleable iron with NPT threaded hubs and male ends. Throats shall be smooth and free from burrs. All such fittings shall be OZ/Gedney Type "9" Series, Appleton, or equal.

G. Rigid metallic conduit split couplings shall have threaded body with split tightening shelves with neoprene sandwich. Furnish malleable iron mechanically galvanized body. Such fittings shall be OZ type "SSP", or equal.

H. Rigid metallic conduit grounding bushings shall be aluminum body with threaded hub, bakelite insulated throat, and tin-plated copper ground lug. Furnish OZ/Gedney type ABLG, or equal.

I. Liquid-tight flexible conduit fittings shall be hot-dip galvanized steel body with internal locking ring and ground cone plus external ground wire fitting. Furnish straight or angle connectors as required. All such connectors shall be OZ/Gedney 4Q series, or equal.

J. Rigid metallic conduit expansion/deflection fittings shall consist of galvanized malleable iron hubs with heat-fused epoxy coating, flexible neoprene joining sleeve banded to hubs with stainless steel bands, and with internal bonding jumper and guide cones. Furnish Crouse-Hinds type "XDHF" or equal.

K. Rigid metallic conduit expansion fittings shall consist of metallic barrel joined to hubs at each end. One hub shall be threaded to barrel and other hub shall have slip fit to allow up to four (4") inches

of conduit lateral movement. Provide external bonding jumper for each expansion joint. Furnish Crouse-Hinds type "XJ", OZ Type "AX", or equal.

L. Conduit waterstops for sealing inside of conduit runs shall consist of aluminum pressure discs with sandwiched neoprene seal and with 316 stainless steel hardware. Furnish OZ/Gedney type "CS" series products, as indicated.

2.03 CONDUIT BODIES AND BOXES

A. Conduit bodies such as "C", "LB", "T" and the like pulling fittings shall be zinc coated with malleable iron or aluminum (material shall match conduit). Covers for damp and/or wet location use shall be gasketed cast metal with "wedge-nut" clamps. Covers for dry locations shall be cast aluminum and hardware shall be 316 stainless steel. All covers shall be equipped with clamp type clevises. Furnish Crouse-Hinds Form 7, or Appleton Form "FM7" products.

B. Conduit bodies for use in corrosive areas shall be as specified above but shall have 40 mil plastic coated PVC jacket and 2 mil interior coating as specified for plastic coated rigid steel conduit. Furnish Robroy Plasti-bond Red fittings or equal.

C. Conduit bodies such as "GUA", "GUAT", "GUAL", and the like pulling/splicing fittings shall be cast aluminum with threaded cast aluminum covers. All such conduit bodies shall be Killark "GE" series, or equal products by Crouse-Hinds or Appleton.

D. Cast metal outlet boxes, pullboxes, and junction boxes whose volume is smaller than 100 cubic inches, and cast metal device boxes, shall be sand-cast, copper-free aluminum or zinc coated sand-cast malleable iron. All boxes shall have threaded hubs. Furnish Crouse-Hinds "FD" style condulets, Appleton "FD" style Unilets, or equal.

E. Covers for cast metal boxes shall be gasketed cast metal covers with 316 stainless steel screws and shall be suitable for use in wet or damp locations.

2.04 PULL AND JUNCTION BOXES

A. Pullboxes and junction boxes whose volume is less than 100 cubic inches shall be furnished as specified hereinbefore except where sheet metal types are shown, in which case, furnish such sheet metal enclosures in NEMA 4X 316 stainless steel construction with gasketed covers of same material.

B. Pullboxes and junction boxes whose volume is 100 cubic inches and greater shall be NEMA 4X 316 grade stainless steel type with gasketed stainless steel covers. Provide print pocket and interior back panel for mounting of terminal strips where terminal strips are called for on the drawings. Sheet metal boxes shall be as manufactured by Hoffman or equal.

C. Covers for sheetmetal pullboxes and junction boxes over 100 cubic inches (and for smaller sized where shown) shall have hinged doors. All hardware shall be 316 stainless steel.

D. Cast metal junction boxes shall be cast aluminum type with gasketed, cast metal covers and with stainless steel cover screws.

2.05 LABELS

A. Buried conduit marking tape for marking path of secondary buried conduits shall be four (4") inch nominal width strip of polyethylene with highly visible, repetitive marking "BURIED CONDUIT" or similar language, repeated along its length.

B. Voltage warning labels for cabinets shall be waterproof vinyl strips with adhesive back and shall have "DANGER (VOLTAGE) - DISCONNECT ALL SOURCES OF POWER BEFORE ENTERING". Letters shall be highly visible red color on white background.

2.06 SUPPORTING DEVICES

A. Mounting hardware, nuts, bolts, lockwashers, and washers, shall be Grade 304 stainless steel.

B. Unless otherwise indicated, channel framing and supporting devices shall be manufactured of ASTM 6063, TO6 grade aluminum; 1-5/8" wide x 3-1/4" deep (double opening type). Clamp nuts for use with channels shall be grade 316 stainless steel.

C. Where indicated, furnish grade 316 stainless steel slotted channel members 1-5/8" wide x 1-5/8" deep or 1 5/8" x 3 1/4" deep, double-faced type. All hardware and conduit clamps shall be grade 316 stainless steel.

D. Conduit clamp supports for terminating conduits onto cable trays shall be mechanically galvanized malleable iron with adjustable angle clamp. Fittings shall be provided with 316 stainless steel hardware. Furnish OZ/Gedney type CTC products.

E. All such channel members and fitments shall be B-Line, Unistrut or equal.

F. Conduit straps, and associated nuts, lockwashers and bolts for use with channels shall be 316 stainless steel with 316 stainless steel hardware. Furnish B-Line products or equal.

G. After-set concrete inserts (drilled expansion shields "D.E.S.") shall consist of two types. For anchors to accommodate 5/16" diameter bolts and smaller, provide HILTI "HDI" series 304 stainless steel anchors. For anchors to accommodate 3/8" diameter and larger bolts, provide HILTI "HVA" series with 316 stainless steel threaded inserts.

H. Hanger rod shall be 3/8" minimum diameter Type 316 stainless steel all-thread.

I. One hole conduit clamps shall be two piece nest-back or clamp-back type constructed of cast malleable iron or cast copper-free aluminum. The material shall match the conduit. Furnish Crouse-Hinds series 500 clamp and series CB spacer, T&B series 1270/1280 clamp + series 1350 spacer (add suffix "al" for aluminum items for T&B parts), OZ\Gedney 14G clamp + series 141G spacer + 141NG nestback (if required), or equal. Finish for malleable iron items shall be hot dip galvanized

J. Conduit beam clamps shall be hot-dip galvanized malleable iron and shall be as follows:

TYPE	MANUFACTURER
Right Angle	OZ/Gedney Type "UBCG", or equal.
Parallel	OZ/Gedney Type "UPCG", or equal.
Edge	OZ/Gedney Type "UECG", or equal.

K. Hanger rod beam clamps shall be clamp type with hardened steel, bolt, Steel City "500" Series, Crouse-Hinds series "500", or equal. Furnish swivel stud for each rod make- up.

L. Conduit "J" hangers shall consist of steel straddle with detachable bolt. Finish shall be electro-galvanized. Furnish Kindorf type "C-149", Unistrut "J-1200" Series, or equal.

M. Conduit "U" bolts shall be hot-dip galvanized steel with 316 stainless steel hex-head bolts.

N. Equipment stands for supporting devices such as control stations, device boxes and the like, shall consist of a welded structural steel c-channel and plate steel floor plate as detailed on the drawings. Equipment stands shall be hot-dipped galvanized after fabrication.

2.07 MISCELLANEOUS MATERIAL

A. Double bushings for insulating wiring through sheet metal panels shall consist of mating male and female threaded phenolic bushings. Phenolic insulation shall be high-impact thermosetting plastic rated 150 degrees C. Furnish OZ Type "ABB", or equal.

B. Conduit pull-cords for use in empty raceways shall be glass-fiber reinforced tape with foot-marked identification along its length. Furnish Thomas, Greenlee, or equal products.

C. Conduit thread coating compound shall be conductive, non-galling, and corrosion-inhibiting. Furnish Crouse- Hinds Type "STL", Appleton Type "ST", or equal.

D. Plastic compound for field-coating of ferrous material products shall be PVC in liquid form that sets-up semi- hard upon curing. Furnish Rob Roy "Rob Kote", Sedco "Patch Coat", or equal.

E. Zinc spray for coating galvanized steel threads shall be Research Laboratory type "LPS", Mobil "Zinc-Spray" or equal conductive zinc-rich spray enamel product.

F. Foam sealant for waterproofing uses shall be "AV280 Hydrofoam" by Avanti Internarional of Webster, Texas or equal.

PART 3 - EXECUTION

3.01 RACEWAYS

A. Install the conduit system to provide the facility with the utmost degree of reliability and maintenance free operation. The conduit system shall have the appearance of having been installed by competent workmen. Kinked conduit, conduit inadequately supported or carelessly installed, do not give such reliability and maintenance free operation and will not be accepted.

B. Raceways shall be installed for all wiring runs, except as otherwise indicated.

C. Conduit sizes, where not indicated, shall be N.E.C. code-sized to accommodate the number and diameter of wires to be pulled into the conduit. Unless otherwise indicated, 3/4" trade-size shall be minimum size conduit.

D. Unless otherwise noted, conduit runs shall be installed exposed. Such runs shall be made parallel to the lines of the structure. Conduit shall be installed such that it does not create a tripping hazard or an obstruction for headroom.

E. All runs of rigid conduit shall be threaded, and all male threads shall be coated with non-galling thread compound prior to assembly.

F. Plastic coated metallic conduit lengths shall be joined with threaded metallic coupling that shall be each equipped with a 40 mil thickness sleeve that shall extend over the threads of the joined conduit. Each joint shall be watertight.

G. Field-cut threads in runs of plastic coated metallic conduit shall be cut with a special die that has rear reamed out oversize so as to slip over plastic coating. Do not attempt to cut threads on plastic coated conduit with regular dies, whereby plastic coating is skinned back to allow the incorrect die to be used. Coat all field-cut threads with cold-galvanizing spray, use two coats to provide 1-mil minimum coating thickness.

H. Conduit runs made in concrete pours or surface-mounted runs that are attached to the structure shall be equipped with an expansion/deflection fitting where they cross an expansion joint, or at every 100 feet.

I. Unless otherwise shown, conduit penetrations through floors located below enclosures, shall be made each with couplings set flush with the outside faces of the concrete pour. Each pair of couplings shall be joined with a threaded spool piece. Use coated aluminum or galvanized steel couplings.

J. Rigid metallic conduit runs shall have their couplings and connections made with screwed fittings and shall be made up wrench-tight. Check all threaded conduit joints prior to wire pull. Coat all male threads with Crouse-Hinds "STL" or equal, conductive lubricant prior to joining.

K. All conduit runs shall be watertight over their lengths of run, except where drain fittings are indicated. In which cases, install specified drain fittings.

L. Plastic jacketed flexible steel conduit shall be used to connect wiring to motors, limit switches, bearing thermostats, and other devices that may have to be removed for servicing. Unless otherwise indicated, maximum lengths of flex shall be three (3') feet.

M. Where plastic jacketed flex is installed, make up terminal ends with liquid-tight flex connectors. In wet locations, install sealing gaskets on each threaded male connector. Each flex connector shall be made-up tightly so that the minimum pull-out resistance is at least 150 lbs. Install external spirally-wrapped ground wire around each run of liquid-tight flex and bond each end to specified grounding-type fittings.

N. Empty conduits shall have pull-ropes installed. Identify each terminus as to location of other end and trade size of conduit. Use blank plastic waterproof write-on label and write information on each label with waterproof ink. Pull a mandrel through each conduit to check and clear blockage before installing pull-rope. Owner’s representative shall witness test. Provide documentation that all conduits are clear and ready for future use. Cap exposed ends of empty conduit with threaded plugs.

O. Conduit runs into boxes, cabinets and enclosures shall be set in a neat manner. Vertical runs shall be set plumb. Conduits set cocked or out of plumb will not be acceptable.

P. Conduit entrances into equipment shall be carefully planned. Cutting away of enclosure structure, torching out sill or braces, and removal of enclosure structural members, will not be acceptable.

Q. Use approved hole cutting tools for entrances into sheet metal enclosure. Use of cutting torch or incorrect tools will not be acceptable. Holes shall be cleanly cut and they shall be free from burrs, jagged edges, and torn metal.

R. All raceways shall be swabbed clean after installation. There shall be no debris left inside. All interior surfaces shall be smooth and free from burrs and defects that would injure wire insulation.

3.02 CONDUIT BODIES AND BOXES

A. Conduit bodies such as "LB", "T", "GUAT", etc., shall be installed in exposed runs of conduit wherever indicated and where required to overcome obstructions and to provide pulling access to wiring. Covers for such fittings shall be accessible and unobstructed by the adjacent construction. GUA series pulling bodies rather than LB fittings and the like, shall be used for splicing purposes as well as pulling access.

B. Covers for all conduit bodies shall be installed with gasketed cast metal type where located in damp or wet locations.

C. All conduit boxes installed whose inside volume is less than 100 cubic inches shall be cast metal type with gasketed cast metal cover, unless otherwise indicated.

D. All conduit boxes whose inside volume exceeds 100 cubic inches shall be sheet metal type except where gasketed cast metal type, stainless steel or fiberglass reinforced polyester are indicated.

3.03 RACEWAY SUPPORT

A. All raceway systems shall be adequately and safely supported. Loose, sloppy and inadequately supported raceways will not be acceptable. Supports shall be installed at intervals not greater than those set forth by the NEC, unless shorter intervals are otherwise indicated, or unless conditions require shorter intervals of supports.

B. Multiple runs of surface mounted conduit on concrete or masonry surfaces shall be supported off the surface by means of aluminum channels. Attach each slotted channel support to concrete surface by means of two (2) 1/4" diameter stainless steel bolts into drilled expansion shields.

C. Single runs of surface mounted conduit on concrete or masonry surfaces shall be supported with hot-dipped malleable iron conduit clamps and nest-back spacers. Furnish plastic coated malleable iron conduit clamps and nest backs where corrosive areas are called out.

D. Conduit runs that are installed along metallic structures shall be supported by means of hot-dipped galvanized beam clamps as specified herein.

3.04 LABELING

A. In addition to labeling requirements as specified throughout this and other Sections, install wiring and raceway labeling as follows:

1. Apply write-on identification to empty conduits to identify each conduit as to terminus of other end and also to identify trade size of conduit.

2. Where active conduits terminate into bottoms of motor control centers, install label on each conduit terminus and show number and size of wiring and function of circuitry and trade size of conduit.

END OF SECTION

26 01 20 Wire and Cable

PART 1 - GENERAL

1.01 SCOPE

A. This section shall include wire and cable, terminating devices, splice kits, labeling, and appurtenances.

1.02 STANDARDS

A. ASTM

B. UL 1277 Electrical Power and Control Tray Cables

C. UL 1685 Flame Exposure Test for Tray Cables

D. ICEA T-29-520 Vertical Cable Tray Flame Test

E. IEEE 1202 Flame Testing of Cables for use in Cable Tray

1.03 SUBMITTALS AND SHOP DRAWINGS

A. Process catalog submittals for the following:

1. Power and control cable
2. Instrument cable
3. Conductor Connectors
4. Tape Products
5. Labels

PART 2 - PRODUCTS

2.01 WIRE AND CABLE

A. All conductors shall be soft-drawn annealed copper, Class B stranding that meets ASTM B-8. Copper conductors shall be uncoated, except as otherwise specified.

B. Single conductor cable for power, control, and branch circuits shall have cross-linked polyethylene insulation, rated for 600 volts. Cable shall be NEC type XHHW-2. All such cable shall be rated for wet or dry use. Cable insulation shall be color coded with factory pigmented colors below size #6 awg. Color coding shall be as specified under Part 3 of this section. Cable shall be as manufactured by Southwire or equal.

C. Instrument cable for analog circuits, shall be # 16 awg, twisted shielded pairs or triads with PVC insulation and overall jacket. Cable assembly shall be rated for 600 volts, wet or dry locations. Furnish Okonite "Okoseal-N Type P-OS" or approved equal.

D. Single conductor cable for 24 volt dc control shall be minimum size #16. Furnish MTW type insulation for panel wiring and XHHW-2 insulation for field wiring in conduits.

E. Single conductor cable 1/0 and above for use in cable trays shall be rated for CT (cable tray) use. Insulation shall be cross-linked polyethylene, XHHW-2. Furnish Southwire XHHW/TC or approved equal.

F. Multi-conductor power cable for use in cable trays shall be 600 volt and rated for CT use. Cable assembly shall be three or four conductor with ground conductor. Insulation of each conductor shall be cross-linked polyethylene, XHHW. Ground shall be bare. Cable assembly shall have an overall PVC jacket. Furnish Southwire type TC or approved equal.

G. Multi-conductor control cable for use in cable trays shall be 600 volt and rated for CT use. Insulation of each conductor shall be cross-linked polyethylene, XHHW. Cable assembly shall have an overall PVC jacket. Furnish Southwire type TC Control Cable or approved equal.

H. Multi-conductor instrumentation cable for use in cable trays shall be 600 volt rated and rated for CT use. Cable assembly shall consist of shielded pairs or triads with overall shield and Nylon jacket. Conductor insulation shall be flame retardant PVC. Furnish Okonite Company “Okoseal-N Type SP-OS or approved equal.

I. Multiconductor cable for connection of the output of VFDs to motors shall be 90 deg C rated, 2000 volt copper conductors with RHW insulation, copper tap shield and groiund conductors. Furnish Service Wire Company "ServiceDrive" or equal cable.

J. Ground mat and associated upcomers and grounding conductors shall be tin-plated stranded copper.

K. Cable for RS485 applications shall be Belden #9841.

2.02 CONNECTORS

A. Mechanical connectors for 600V class wiring shall be tin-plated copper alloy bolted pressure type with bronze tin-plated hardware. Furnish connectors as follows:

TYPE	MANUFACTURER & TYPE
Single conductor to flat-plate connector	Blackburn LH
Multiple conductor to flat-plate connector	Blackburn L2H, L3H, L4H
Split-bolt connector	Blackburn HPS
Two-bolt parallel connector with spacer	Blackburn 2BPW
Cross Connector	Blackburn XT
Splice Connector	Blackburn S

Flush ground connector OZ Type "VG"

B. Insulated spring wire connectors, "wire-nuts", for small building wire taps and splices shall be plated spring steel with thermoplastic jacket and pre-filled sealant. Connector shall be rated for 600 volts, 75 degrees C continuous. Furnish King Technology, or equal.

C. Connectors for control conductor connections to screw terminals shall be crimp-type with vinyl insulated barrel and tin-plated copper ring-tongue style connector. Furnish T&B "Sta-Kon", 3M "Scotchlok", or equal.

D. Terminal strips for miscellaneous field terminations of control and instrumentation circuits shall consist of 12 point box lug terminals with marking surface. Terminal assembly shall accept #18 to #12 awg and shall be rated 600 volts. Furnish Allen-Bradley #1492-HJ812 terminal blocks.

2.03 INSULATING PRODUCTS

A. Tape products shall be furnished as hereinafter specified and shall be Plymouth, Okonite, 3M, or equal.

B. General purpose electrical tape shall be 7 mil thick stretchable vinyl plastic, pressure adhesive type, "Slipknot Grey", 3M Scotch 33+, or equal.

C. Insulating void-filling tape and high voltage bedding tape shall be stretchable ethylene propylene rubber with high-tack and fast fusing surfaces. Tape shall be rated for 90 degrees C continuous, 130 degrees C overload, and shall be moisture-proof. Void filling tape shall be "Plysafe", 3M Scotch 23, or equal.

D. High temperature protective tape shall be rated 180^{o}C continuous indoor/outdoor, stretchable, self-bonding silicone rubber. High temperature tape shall be Plysil #3455, 3M Scotch 70, or equal.

E. Insulation putty filler-tape shall be Plymouth #32074, 3M Scotchfill, or equal.

F. Arc and fireproofing tape shall be Plymouth #3318, 3M Scotch #70 or equal.

2.04 LABELS

A. Colored banding tape shall be 5 mil stretchable vinyl with permanent solid color. Colors shall be as hereinafter specified. Tape shall be Plymouth "Slipknot 45", 3M Scotch #35, or equal.

B. Numbered wire marking labels shall be PVC sleeve-type markers, T&B, Brady or equal. Markers using adhesive are not acceptable.

C. Cable identification ties shall be weather resistant polyester with blank write-on space, T&B, Brady or equal.

2.05 MISCELLANEOUS MATERIAL

A. Cable grips shall be 316 SS grip-type wire mesh with machined metal support. Furnish Kellems, Appleton, or equal products.

B. Wire pulling compound shall be non-injurious to insulation and to conduit and shall be lubricating, non- crumbling, and non-combustible. Furnish Gedney "Wire- Quick", Ideal "Yellow" or equal.

C. Fiber Optic Patch Panels shall be 12 fiber with SC connectors. Furnish Corning SPH-01P units. Furnish two patch panels per RTU enclosure. One shall be for the 6 fiber cable ring and the other shall be for interconnection of fiber optic cables for the video surveillance system cameras.

D. Patch cables shall be factory terminated and tested in lengths as needed with SC or ST connectors as required. Furnish Industrial Networking Solutions or equal products.

E. Conduits for concrete encased ductbanks that are supported by piers shall be fiberglass conduits manufactured by Champion.

PART 3 - EXECUTION

3.01 POWER AND CONTROL CABLE

A. Power and control conductors shall be sized as shown and where no size is indicated, the conductor size shall be #12 awg for power circuits #14 awg for 120 vac control circuits, and #16 awg for instrumentation circuits.

B. Equipment grounding conductors shall be installed with type XHHW insulated stranded copper conductors and the insulation color shall be green in sizes up to and including #10 awg.

C. Color coding shall be as follows. Non-factory color coded cables shall be marked with specified color tape. Use the following colors:

CONDUCTOR	120/208V SYSTEMS	480V SYSTEMS
Phase A or L1	Black	Brown
Phase B or L2	Red	Orange
Phase C	Blue	Yellow
Neutral	White	N/A
Ground	Green	Green

D. Branch circuits may be spliced for receptacle, lighting and small appliance load inside appropriate junction boxes. Feeders, branch circuit, power wiring, control wiring, and signal wiring shall be installed without splice.

E. Except as otherwise specified, taps and splices with #10 AWG and smaller, shall be made with insulated spring wire connectors. Such connectors in damp or wet locations shall be waterproofed by filling interstices around wires with silicone rubber and further insulating with an envelope of stretched piece of EPR tape around each wire. Then, apply one-half lapped layer of electrical tape over all.

F. Motor connections made with #10 AWG and smaller wire shall be made up with set-screwed copper lugs with threaded-on insulating jacket. After make-up of each connector, install two (2) layers half-lapped, of high temperature tape over connector barrel and down one (1") inch over wires.

G. Taps, splices, and connections in #8 AWG and larger wires shall be made with copper alloy bolted pressure connectors. Each such connector shall be insulated by means of applying insulation putty over sharp edges so as to present a smooth bonding surface. Next, apply at least four (4) layers, half-lapped each layer of EPR tape. Then, make final wrapping of at least three (3) layers, half-lapped each layer of electrical tape.

H. Control wiring connections to stud type and screw type terminals shall be made with ring-tongue type crimp connectors. Label each terminal jacket with wire marking label at each connection.

I. Each wire connection shall be made up tightly so that resistance of connection is as low as equivalent length of associated conductor resistance.

J. Numbered marking labels shall be installed to identify circuit numbers from panelboards. Install labels on each wire in each panelboard, junction, pullbox and device connection.

K. Label each wiring run with write-on waterproof labels inside motor control center. Install write-on label ties around wire group at conduit entrance and write-on label the wire size, conduit size and service.

L. Install PVC sleeve type numbered marking on each control wire termination at each terminal strip and at each device. Do this in motor control center, terminal cabinets, safety switches, remote controllers, pilot operators, and instrumentation equipment. Number selected shall correspond to number on terminal strip.

M. All wiring inside equipment enclosures shall be neatly trained and laced with nylon tie-wraps.

N. Tie wrap cables in tray.

3.02 INSTRUMENTATION WIRING

A. All 4-20mA analog pairs shall have shields grounded at the instrumentation panel and insulated on the field end unless otherwise required by instrument supplier. Single point grounding shall be maintained.

3.03 GROUND WIRING

A. Each item of equipment shall be adequately and thoroughly grounded. Comply with Article 250 of N.E.C., except where higher standards of grounding have been specified. In addition to requirements as specified under Section 26 04 50, install grounding for general wiring systems as follows.

B. Equipment grounding conductors (EGC) shall be installed in each run of power and control conduits. These wires shall be green colored in sizes #6 AWG and smaller and green banded in larger sizes. Ground wires shall be type XHHW-2 insulated copper wires.

C. EGC runs into equipment shall be grounded to equipment bus where available, or to equipment ground lugs.

D. Where grounding type bushings are installed, bond EGC thereto, and furthermore, ground each bushing lug to equipment ground bus or ground lug, or ground rod.

E. In each motor terminal box, install equipment ground lug and connect EGC thereto. Bond pump frame to motor frame. Bond motor and pump to grounded electrode conductor.

F. Run continuous ground in tray, bond to each section and to all switchgear, panels, and transformers.

3.04 LABELING

A. In addition to labeling requirements as specified throughout this Section, install wiring and raceway labeling as follows:

1. Apply numbered wire marking labels to control wiring terminations for each termination in each item of equipment. Use PVC sleeve type labels.

2. Apply numbered wire marking labels to power and control wiring terminations in motor control centers, panelboards, and at outlets, to identify circuit numbers. Use PVC sleeve type labels.

3. Apply numbered wire marking labels to each signal wire termination in each instrument junction box, and in each item of equipment served by instrumentation circuits. Use PVC sleeve type labels.

4. Apply write-on identification labels to wiring sets in each motor control center, and in each pullbox and junction box. Show wire size, conduit size, and line and load information. Use waterproof plastic write-on labels with nylon tie-wraps.

3.05 TESTING

A. Each run of 600V class power and control wiring shall be tested prior to connection of line and load. Make tests with 1000V dc hand-crank or motor driven ohmmeter. Each run of wiring shall be tested phase-to-phase and/or phase-to-neutral, and phase-to-ground. Test results for each test shall be equal to or greater than 25,000,000 ohms with 1000V dc applied. All tests shall be made in the presence of the Owners representative or Engineer.

B. Test all runs of signal wiring with 250V dc megger. Insulation values shall meet or exceed 1,000,000 ohms per 100 feet (cable to shield).

C. Should any cable or circuit fail to meet the above tests, replace wire and retest.

3.06 FIBEROPTIC CABLE INSTALLATION

A. The fiberoptic cable shall be installed and terminated per the manufacturer's installation guidelines for the particular cable. No splices shall be made in manholes without prior approval.

B. Connectors shall be compatible with the fiberoptic equipment specified in Section 4.1.18.04. Terminations shall be made by qualified technicians trained in the termination of fiberoptic cables. Specified testing shall be performed after all terminations are made.

C. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B (B.1, B.2, B.3) and any additional requirements with respect to the extended

product and/or application assurance warranties. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

D. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project engineer/designer for clarification and resolution.

END OF SECTION

No specifications on this page for formatting purposes.

26 01 91 Dry Type Transformers

PART 1 - GENERAL

1.01 SCOPE

A. This section refers to dry-type transformers. Furnish and install transformers as shown on the Drawings and as specified hereinafter.

1.02 STANDARDS

A. Dry-type transformers shall be listed by UL and shall comply with UL-506, NEMA ST-20.

1.03 SUBMITTALS

A. Process catalog submittals on dry type transformers.

PART 2 - PRODUCTS

2.01 GENERAL

A. Dry type transformers 30 kVA and below shall be totally enclosed non-ventilated, 115^{O}C rise. Core and coil shall be totally encapsulated in sand and resin or equivalent. Dry type transformers above 15 kVA shall be ventilated with 220^{O}C rated insulation and 115^{O}C rise.

B. Each transformer shall be equipped with two 2.5% full-capacity below normal and two 2.5% full capacity above normal taps.

C. Furnish transformers in KVA and voltage ratings as shown on the Drawings. Transformer enclosure shall be suitable for outdoor use. Enclosure shall be rated 3R.

D. Sound level of each transformer shall not exceed 60 db at three feet.

E. Transformer shall have electrostatic shield.

F. Furnish General Electric, Cutler-Hammer, Square D, Siemens, or equal products.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install transformers where shown. Adequately support wall-mounted transformers. Top bolt shall be 1/2" and shall extend though CMU wall and shall have bolt head and 2" square by 1/8" thick hot-dipped galvanized washer on the outside. Waterproof penetration. Use stainless steel bolt and hardware.

B. Bond neutral of each transformer to its enclosure and to grounding electrode conductors per NEC article 250. Install grounding electrode conductors from transformer secondary neutral to ground mat.

END OF SECTION

No specifications on this page for formatting purposes.

26 01 92 Lighting Panelboards

PART 1 GENERAL

1.01 SCOPE

A. This specification covers the requirements for 240 volt and 208 volt lighting panelboards.

B. This specification defines minimum requirements, characteristic guidelines and features required.

1.02 STANDARDS

A. All panelboards shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA. Panelboards shall be UL listed.

1.03 SUBMITTALS

A. Submit outline and dimensional drawings and catalog literature to Engineer for review.

PART 2 PRODUCTS

2.01 GENERAL

A Ratings shall be as indicated on the drawings.

B Circuit Breakers shall be bolt on and rated 10,000 amps rms symmetrical interrupting capacity.

C Panelboards shall have integrated SPD rated for 120 kA. Provide alarm contacts, event counter, and indicator lights.

2.02 CONSTRUCTION

A. All buses shall be tin-plated copper.

B. Enclosures shall be painted steel.

C. NEMA 12 for installation indoors, NEMA 4 for installation outdoors.

2.03 MANUFACTURER

A. Panelboards shall be Square D type NQ or equal product by Eaton, General Electric or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards as scheduled and in locations shown on the drawings. Provide grounding as specified per 26 04 50 and per NEC.

END OF SECTION

No specifications on this page for formatting purposes.

26 01 95 Mechanical Equipment Control Panels

PART 1 - GENERAL

1.01 SCOPE

A. This section covers control panels furnished with process equipment. Furnish and install all equipment and materials as shown on the drawings and specified herein. Work shall include all necessary materials, equipment, labor, and services.

B. Auxiliary and accessory devices necessary for system operation or performance, such as relays din connectors, or terminals to interface with other Sections of these Specifications, shall be included.

1.02 QUALITY ASSURANCE

A. Comply with Section 26 09 10 Instrumentation

1.03 RELATED WORK

Section 26 09 10, Instrumentation
Section 26 09 30, SCADA

1.04 SUBMITTALS AND SHOP DRAWINGS

A. Submittals shall be in accordance with the requirements outlined in Section 01330-Submittals.
B. Process catalog submittals, and equipment data for the following:

1. Enclosures
2. Motor starters
3. Circuit breakers
4. Enclosure Air Conditioners
5. PLC's

C. Submit shop drawings for dimensional, layout and wiring.

PART 2 - PRODUCTS

2.01 Enclosures

A. Enclosures shall be NEMA 4X, constructed of 316 stainless steel. Where enclosure has main breaker, furnish enclosure that can accommodate flange mounted disconnect.

B. Enclosures shall be Hoffman, Hubbell/Wiegmann, or approved equal.

2.02 Enclosure Fans

A. Panel fans shall be provided for enclosures with electronics (PLC, remote IO, Sensor displays) if the operating temperature rating of the equipment is exceeded and cannot be maintained by sun shields, solar shields, painting outside of enclosure white, or other means.

B. Enclosure fans shall be sized to maintain an internal temperature of 90 degrees F, with an outside dry bulb temperature of 110 degrees F.

C. Enclosure fans shall be Hoffman, Hubbell/Wiegmann or approved equal.

2.03 Motor Starters

A. Motor starters shall consist of NEMA rated contactors and magnetic motor circuit protector circuit breakers. 480 volt motor starters shall have an interrupting rating of 18,000 amps rms symmetrical. 240 volt and 208 volt motor starters shall have an interrupting rating of 10,000 amps rms symmetrical.

B. Motor starters shall be Eaton, Square D, Allen-Bradley, or General Electric.

2.04 Variable Speed Drives

A. Variable Speed Drives up to 50 hp shall be 6 pulse drives as manufactured by Eaton, Square D, Allen-Bradley or Toshiba.

B. All drives over 1 hp shall have active filter. Furnish MIRUS International LINEATOR series or equal product by MTE.

2.05 Disconnects and Circuit Breakers

A. Disconnects shall be flange mounted with cable connected operator. Door mounted operators are not acceptable.

B. Disconnect operator mechanism shall be as manufactured by Eaton, Square D, General Electric, or Allen-Bradley.

C. 480 volt circuit breakers shall have an interrupting rating of 18,000 amp rms symmetrical. 240 volt, 208 volt, and 120 volt circuit breakers shall have an interrupting rating of 10,000 amps rms symmetrical.

2.06 Programmable Logic Controllers

A. PLC's shall be Allen-Bradley CompactLogix #1769-L33ER. PLC shall have 2 Ethernet ports, 1 USB port & 2mb of available user memory.

B. PLC power supply accepts 24vdc input. PLC power supply module shall be Allen Bradley #1769-PB4

C. PLC shall have expansion I/O modules as required to accommodate the I/O scheduled on the drawings.

D. Digital input modules shall have 16 digital 24vdc inputs. Discrete input module shall be Allen Bradley #1769-IQ16.

E. Discrete output module shall have 8 individually isolated relay outputs with 2 amp contact ratings at 24vdc. Discrete output module shall be Allen Bradley #1769-OW8I.

F. Analog input modules shall be isolated 4-20ma differential input type, 8 channels per module. Analog input modules shall be Allen Bradley #1769-IF8.

G. Analog output modules shall have 4 individually isolated 4-20ma outputs. Analog output modules shall be Allen Bradley #1769-OF4CI.

H. Where OI panels are required, OI panel shall be 12" color graphic touch screen compatible with the Allen Bradley PLC system protocols. OI panel shall be Panelview Plus by Allen Bradley or approved equal.

I. Each manufacturer shall provide 1 spare module for each module type. This includes (1) Power Supply module, (1) CPU module, (1) Analog Input module, (1) Analog Output module, (1) Discrete Input module, and (1) Discrete Output module. Allow additional module space large enough to add 2 more future I/O modules.

J. SCADA system wiring is 24 volts dc, all dry contacts for status or alarm will be sensed with 24 volt dc. Provide an interface relay with a 24 volt dc coil for any run or run enable function that interfaces with the plant SCADA system. As a minimum, provide one such relay and label spare if this interface is not required.

2.07 Miscellaneous

A. Terminal strips for connection of field wiring shall be DIN rail mounted channel mounted terminals suitable for connecting #22 to #12 wire sizes. Furnish AMP model FB6/1-604101-1 with BND-100 DIN mounting channel. Terminal strips shall have factory terminal markers.

B. Control relays shall be 4 pole double throw with pin base and matching socket. Relays shall have LED indicator. Furnish Idec model RY4S-ULDC24V with model SY4S-05 din rail mounting socket.

C. Furnish control panel devices as indicated in the drawings. 120 vac pushbuttons, selector switches, and pilot lights shall be NEMA 4X, Allen-Bradley type 800H or equal. Pilot lights shall be LED type and shall have push-to-test option.

D. DC power supplies shall be provided where required and as indicated on the drawings. DC power supplies shall be 24 VDC, in amp output rating indicated on the drawings. Minimum rating shall be 5 amps when no size is shown. DC power supplies shall be switching type, Phoenix Contact or equal.

E. Enclosure shall be built per UL 508 and shall have UL 508 label.

PART 3 - EXECUTION

3.01 PLC PROGRAMMING

A. Programming shall be as required by the process equipment requirements. Provide register maps of points for status, alarms, and any process analog values used in the control scheme. It is the intent for the local PLC in the manufacturer's panel to control the process automatically with the HMI down. It is the intent to allow register exchange for adjustable setpoints to alleviate the need for touch screens or local operator interface panels (OIP) if that is the only reason for the existence of the OIP.

B. The PLC shall be programmed to map an image of ALL hardware inputs and outputs into a data array to facilitate efficiency of the SCADA system to read & write data to and from each node. In addition, any internally generated status or alarm bits shall be mapped into a register of the array. The programmer shall provide an excel spreadsheet to the engineer detailing any operator adjustable setpoints or timer presets.

C. Prior to startup, individual equipment IP addresses will be provided by engineer. It will be the responsibility of the equipment manufacturer to implement the assigned IP address and subnet mask so that the CPU will be compatible with the SCADA system network.

D. Provide documentation of programs with O&M Manuals. Include a CD containing all of the associated program files and a pdf file of the printed program and pdf files containing theory of operations, electrical schematics and users manuals.

3.02 GENERAL

A. Each manufacturer's panel has devices remote from the control panel as described in each equipment specification. Allow in bid for installation of conduit and wire to connect each remote device to the manufacturer's panel.

END OF SECTION

26 04 10 Underground

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install a system of underground raceways and wiring as shown on the drawings.

1.02 APPLICATIONS

A. Except as otherwise shown on the Drawings, or otherwise specified, all underground and in-slab conduit raceways shall be of the following type:

1. For small diameter conduits for instrumentation and feeder circuits, conduit runs shall be made with schedule 40 PVC. Bends to grade shall be made with plastic coated rigid steel conduit. All conduit coming out of the ground in grass areas shall have concrete mow protection as detailed on the drawings. Plastic coated conduit in all cases shall extend 3" above the concrete.

2. All instrumentation underground conduit runs shall be made with schedule 40 PVC conduit with plastic coated rigid metallic conduit upturns. A 24" separation shall be maintained from power conduit ductbanks or if in the same ductbank, it shall be plastic coated rigid steel conduit the whole way.

1.03 SUBMITTALS

A. Process submittals for the following:

1. Non Metallic conduit
2. Metallic conduit
3. Grounding Bushings
4. Buried conduit marker tape
5. Conduit supporting saddles

1.04 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

A. Refer to Section 26 01 10 for raceways.

B. Refer to Section 26 01 20 for wiring.

C. Refer to Section 26 04 50 for grounding.

D. Refer to Division 3 for concrete.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Raceways shall be as specified in Section 26 01 10.

2.02 MISCELLANEOUS

A. Gravel for underbedding of conduits shall be washed type pea gravel.

B. Plastic saddles (where allowed) for spacing and supporting conduits shall be interlocking types as manufactured by Cantex.

C. Plastic marker label tape for buried conduits shall be yellow background with black letters with repetitive marking "ELECTRIC LINE" on yellow background, continuous along its length. Furnish T&B # NA-0608, or equal tape.

PART 3 - EXECUTION

3.01 EXCAVATION AND BACKFILLING

A. Do all excavating and backfilling necessary for the installation of the work. This shall include shoring and pumping in ditches to keep them dry until the work has been installed.

B. All excavations shall be made to proper depth, with allowances made for floors, forms, beams, piping, finished grades, etc. Ground under conduits shall be undisturbed earth or if disturbed, mechanically compacted to a density ratio of 95% before conduits are installed.

C. All backfilling shall be made with selected soil, free of rocks and debris, and shall be pneumatically tamped in six (6") inch layers to secure a field density ratio of 95%.

D. Field check and verify the locations of all underground utilities prior to any excavating. Avoid disturbing these as far as possible. In the event existing utilities are broken into or damaged, they shall be repaired so as to make their operation equal to that before the trenching was started.

E. All concrete ductbanks shall have a red dye in to indicate electrical ductbank. All ductbanks shall be concrete encased. Concrete reinforcement shall comply with ASTM C 1116. Concrete shall have PSI Fiberstrand F or approved equal reinforcement.

F. All concrete encased ductbanks shall be tied into structure with doweled rebar, on each corner, four places minimum.

G. Where conduits turn up provide 6” rise of concrete encasement to protect conduit from mowing.

3.02 RACEWAYS

A. All underground conduits shall be PVC schedule 40 unless otherwise noted. All bends to grade shall be made with plastic coated rigid metallic conduits and shall extend to 6" above grade. Conduits shall be watertight over the entire length of the underground run.

B. Install all power, control, and signal wiring. Label each single conductor wire at each connection with PVC sleeve type wire labels. Label each signal cable at each end with plastic waterproof write-on type label to identify terminal connection and function and device served.

C. Where empty conduits terminate into equipment install blank "disc" under grounding bushing and bring specified foot-marked pull tape through disc. Label each end of each pull tape with waterproof plastic label to identify terminus of other end and also show conduit size.

3.03 WIRING

A. All underground wiring runs shall be installed from line to load without splice.

END OF SECTION

No specifications on this page for formatting purposes.

26 04 50 Grounding

PART 1 - GENERAL

1.01 SCOPE

A. Furnish and install complete grounding systems in accordance with Article 250 of the National Electrical Code as shown on the Drawings and as specified herein.

B. Provide ground mat grounding electrode system as shown on the drawings and as specified herein.

1.02 SUBMITTALS

A. Submit manufacturers' catalog sheets with catalog numbers marked for the items furnished, which shall include:

1. Ground well casings
2. Ground rods
3. Terminal lugs and clamps
4. Exothermal welding materials
5. Ground cable
6. Ground connection hardware

PART 2 - PRODUCTS

2.01 GROUNDING ELECTRODES

A. All ground mat grounding electrodes and grounding electrode conductors shall consist of tin plated stranded copper.

B. All ground rods shall be copper clad steel products, 3/4" diameter x 10 foot long, unless otherwise indicated. Ground rods shall be Blackburn #6258, or equal. Provide heavy duty ground rod clamps, exothermic welds where concealed or below grade. Equal to Blackburn #GG58 where vertical connections are installed and #GUV where U-bolt connectors are installed to serve horizontal connections.

2.02 GROUNDING DEVICES

A. Connectors shall be furnished as specified under Section 26 01 20.

B. Conduit grounding bushings shall be furnished as specified under Section 26 01 10.

C. Equipment grounding conductors shall be furnished as specified under Section 26 01 20.

D. Flush cast metal grounding plates shall consist of bronze body with flat plate on top and bolted clamp connector on bottom. Furnish OZ type "VG", or equal flush connectors. Each such

connector shall be furnished with silicon bronze connector bolts for installation of top-mounted grounding connectors.

E. Exothermal welding kits shall be "Cadweld" products as manufactured by Erico. Molds, cartridges, powder, and accessories shall be as recommended by the manufacturer.

2.03 GROUND TEST WELLS

A. Ground test wells shall be furnished each ground rod for the purpose of field testing the ground mat system.

B. Ground test wells shall each consist of ground rod with connector attached to a #4 upcomer from the ground mat and contained within an access well with labeled top.

C. Ground test well enclosures shall be Brooks product #3RT series, or equal. Enclosures shall be 10 1/4" diameter and shall include cast iron cover with integrally cut "GROUND TEST WELL" in top of cover.

PART 3 - EXECUTION

3.01 GROUND MATS AND GROUND WELLS

A. Install ground mat around the perimeter of structures, electrical equipment racks, the generator pad and where indicated on the drawings. Use #4/0 AWG tin-plated copper stranded conductor for the ground mat. Install upcomer with indicated wire sizes of tin plated copper conductors. Exothermally weld all connections.

B. Unless other larger sizes are indicated on the drawings, install #2 upcomers from ground mat to PLC, and other equipment indicated on the drawings. Install "VG" flush floor connector to serve each upcomers and run #2 stingers from top side of each "VG" to ground bus in equipment. Bond VG to rebar in concrete.

C. Install ground rods in test wells where indicated on the drawings.

3.02 TRANSFORMER

A. Bond transformer neutral to cabinet.

B. Install grounding electrode conductor from each transformer neutral to system ground and to local electrodes as shown. Run #2 ground wire to ground mat.

3.03 WIRING SYSTEMS GROUNDING

A. All equipment enclosures, motor and transformer frames, metallic conduit systems and exposed structural steel systems shall be grounded.

B. Equipment grounding conductors shall be run with all wiring. Sizes of equipment grounding conductors shall be based on Article 250 of the N.E.C. except where larger sizes may be shown. Bond each equipment grounding conductor to the equipment grounds at each end of each run. Run 4/0 ground full length of tray, bond to each section and every enclosure where conductors originate or terminate. Protect grounded equipment conductor in conduit where it leaves the tray.

C. Liquid tight flexible metal conduit in sizes 1" and larger shall be equipped with external bonding jumpers. Use liquid tight connectors integrally equipped with suitable grounding lugs.

D. Where conduits enter into equipment free of the metal enclosure, install grounding bushing on each conduit and bond bushing lug to equipment ground bus.

E. Where conduits enter equipment enclosures, equip each penetration inside with grounding bushing. Install bonding jumper from each grounding bushing to ground bus.

F. Equipment enclosures that do not come furnished with a ground bus, install ground lug in each enclosure that shall be bonded to the metal cabinet or backpan of the enclosure.

G. Separately derived systems shall be each grounded as shown and shall comply with Article 250 of the NEC except where higher standards are shown.

3.04 TESTING

A. All exothermic weld connections shall successfully resist moderate hammer blows. Any connection which fails such test or if upon inspection, weld indicates a porous or deformed connection, the weld shall be remade.

B. All exothermic welds shall encompass 100 percent of the ends of the materials being welded. Welds which do not meet this requirement shall be remade.

C. Test the ground resistance of the system. All test equipment shall be furnished by Contractor and be approved by Engineer. Test equipment shall be as manufactured by Biddle or approved equal. Dry season resistance of the system shall not exceed five ohms. If such resistance cannot be obtained with the system as shown, provide additional grounding as directed by Engineer.

END OF SECTION

No specifications on this page for formatting purposes.

SECTION 400002

CHEMICAL METERING PUMP SYSTEM

PART 1 - GENERAL

1.1 Summary

A. Description of the Work

1. The work to be performed in accordance with this section includes all work associated with the installation and testing of all chemical metering pump systems associated with the project.
2. The work shall include the furnishing of all labor, tools, equipment, materials, documentation, training and startup services, and performing all operations to install all skid-mounted chemical metering pump systems.
3. Equipment is to be installed as shown on the plans, as specified herein, as recommended by the supplier and in compliance with all local, state, and federal codes and regulations.

B. Related Work Specified Elsewhere

1. Submittals in Section 01330.
2. Temporary Utilities and Facilities in Section 01560.
3. Equipment and Materials in Section 01600.
4. Equipment and System Start-up and Performance Testing in Section 017516.
5. Spare Parts and Maintenance Materials in Section 017843.
6. Demonstration and Training in Section 017900.

1.2 Reference Standards

A. ANSI B-16.5, Pipe flanges and flanged fittings.

B. American Society for Testing and Materials (ASTM)

C. Hydraulic Institute Standards (HIS)

D. National Electrical Manufacturer's Association (NEMA)

E. NSF Standard 61 Drinking Water System Components, AWWA – Drink Water System Components

F. UL Listing Directory (UL).

G. Manufactured to ISO 9001:2015 requirements and processes.

1.3 Submittals

A. Submit shop drawings in accordance with Section 01330.

B. Submit complete operations and maintenance manuals in accordance with Section 01330.

C. Submittals shall include, but not limited to, the following:

1. Final certified drawings showing outline dimensions, foundation layout, or mounting information, and other pertinent dimensions
2. Detailed shop drawings and product data for the equipment provided, including detailed schematic of equipment, piping, controls, etc.
3. Field erection instructions, assembly drawings and/or diagrams, detailed reference lists and lists of erection details.
4. Schematic and wiring diagrams of power, control and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated.
5. Materials of construction of all components.
6. Standard pump performance data.
7. Pump data sheet confirming pump capacity, required backpressure valve setting, pumped chemical characteristics pipe connection sizes, testing requirements, and appurtenances to be provided with pump.
8. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor specifications.
9. Manufacturer's materials compatibility information, confirming compatibility of wetted parts with specified pumped chemicals.
10. Recommended spare parts list.

1.4 Quality Assurance

A. Manufacturer Quality Assurance

1. The products of this section shall be provided by a single supplier, who shall demonstrate previous experience in the production of skid-mounted chemical metering systems. The manufacturer must have a service center with trained technicians authorized to make repairs to all components of

the chemical feed system. This supplier shall be responsible for providing all equipment, accessories, spare parts, documentation and installation supervision required for a complete and operational chemical feed system.

2. The equipment furnished shall be designed and constructed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per the manufacturer's recommendations.
3. The equipment manufacturer must have experience in the design, manufacture, operation, and servicing of sodium hypochlorite chemical feed systems for drinking water applications of similar performance and reliability to that specified with installations in satisfactory operations for at least 5 years.
4. Pumps shall be warranted by the manufacturer for a period of five years. Warranty shall include chemical damage to the pump head and roller assembly for a period of two (2) years. The system manufacturer shall also provide a two (2) year warranty for the skid material/construction, and skid-mounted equipment, piping, and valves.

1.5 Delivery, Storage, and Handling

A. Materials are to be marked or tagged with part number and order number for field assembly requirements.

B. The chemical feed system shall be factory assembled and tested prior to delivery and shall be delivered to the site fully assembled, except where partial disassembly is required by transportation regulations or for protection of components.

C. The Contractor shall store and temporarily support equipment prior to installation in strict accordance with the Manufacturer's recommendations and instructions.

D. Protect the equipment from being contaminated by dust, dirt, vibration and moisture.

E. The unit shall be erected and lubricated in strict accordance with the instructions of the Manufacturer.

F. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

PART 2 - MATERIALS

2.1 GENERAL

A. The manufacturer shall provide skid mounted chemical metering pump systems complete with chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The metering pump skid shall contain the following items and as generally shown on the Contract Drawings:

1. Chemical resistant skid with in drip containment reservoir
2. Peristaltic metering pumps
3. Flow indicator
4. Flow sensors
5. Chemical feed flowmeters
6. Pump head
7. Pump tube assembly
8. Tubing
9. Drive system, complete with motor, enclosure, and control circuitry.
10. Terminal Box with pumps pre-wired for easy access to all electrical signal wires.
11. Pump shelves
12. Pipe supports
13. Y-Strainer
14. Pressure Relief Valve
15. Backpressure valve
16. Calibration column
17. Pulsation Dampener
18. Ball Valves, vented
19. Check Valves
20. Pressure Gauges with guard
21. Unions for easy pump removal
22. Pressure switch with guard
23. Mounting hardware
24. All piping, valves, gaskets, supports, hardware, wiring, and accessories for a fully functioning skid.

2.2 DESIGN REQUIREMENTS

A. Chemical name: Sodium Hypochlorite

1. Concentration: 12.5%
2. Specific Gravity: 1.07-1.26 @ 20˚C

B. Anticipated chemical use

Water Demand (MGD)	Chemical Dose (gal/hour)
12.2	6.4
18.0	9.4
26.0	13.6
40.0	20.9

C. Number of skid units: 2

D. Number of pumps per skid: 2

E. Equipment Tag Number

1. Skid for Injection Point 1: CFS-100
    a. Pumps:
        i. CFS-PMP-101
        ii. CFS-PMP-102
2. Skid for Injection Point 2: CFS-200
    a. Pumps:
        i. CFS-PMP-201
        ii. CFS-PMP-202

2.3 CHEMICAL FEED SYSTEM

A. Acceptable Model and Manufacturer

a. Blue-White CFPS-2-M CHEM-FEED Duplex Skid System
b. Or Engineer Approved Equal.

2.4 METERING PUMP

A. Acceptable Model and Manufacturer

1. M4 FLEXFLO Municipal peristaltic pump, by Blue-White.
2. Or Engineer Approved Equal.

B. Pump shall be a positive displacement, peristaltic type tubing pump with a brushless variable speed motor, non-spring-loaded roller assembly located in the pumphead, integral tube failure detection system, tube life roller revolution counter with user alarm set-point and flexible tubing with attached connection fittings.

1. Model shall be capable of output volumes from 0.0028 to 158.5 gallons per hour.

C. No valves, diaphragms, springs, or dynamic seals in the fluid path. Process fluid shall contact the pump tubing assembly and connection fittings only.

D. Pump shall be capable of 24-hour continuous duty, self-priming and operating in either direction of flow at the rated maximum pressure of up to 125 PSI.

E. Pump shall be capable of running dry without damage.

F. Pump shall be capable of operating in either direction without output variation.

G. Suction lift shall be capable of 30 feet of water.

2.5 Pump Head

A. Design

1. Shall be a single, unbroken track with a clear removable cover
2. Tube failure detection sensors shall be constructed of Hastelloy C pins that are located at the bottom of the pump head. System shall detect tube rupture by conductive fluid immersion and shall not be triggered with water contact from rain or condensation. Float type switches, Process fluid waste ports, or leak drains are not permitted.
3. Squeeze and guide roller arms shall be removeable for ease of replacement.
4. Rotor assembly shall be installed on a D-shaped, chrome plated motor shaft and removable without tools.
5. For tubing installation and removal, rotor assembly shall be rotated by the motor drive at 6 RPM maximum when the pumphead cover is removed. Hand cranking of the rotor assembly shall not be required.

B. Materials and Construction

1. Pump head and tubing compression surface shall be corrosion resistant Valox thermoplastic.
2. The pump head cover shall be clear, polycarbonate thermoplastic with an integral ball bearing fitted to support the overhung load on the motor shaft. Cover shall include an imbedded magnetic safety interlock which will limit the motor rotation speed to 6 RPM when removed.

3. Cover shall be positively secured to the pump head using a minimum of four thumb screws. Tools shall not be required to remove the pump head cover.

2.6 PUMP TUBE ASSEMBLY

A. Design

1. To ensure pump performance and accuracy, only tubing provided by the manufacturer is acceptable.

B. Connections

1. Pump tube shall be assembled to connect fittings of PVDF material.
2. Connection fittings shall be permanently clamped to the tubing with stainless steel clamps or over molded directly to the tubing. To prevent tubing misalignment and ensure accuracy, fittings shall be inserted into keyed slots located in the pump head and secured in place by the pump head cover.
3. Connection fittings shall be 1/2" M/NPT.
4. Alternate:
   a. Fittings shall accept 1/2" ID flexible tubing.
   b. Fittings shall accept one-way check valve Quick Disconnect Adapters. Wetted components shall be PVDF, Viton, and Hastelloy C spring.
   c. Fittings shall accept ¾" tri-clamp adapters.
5. Tube sizes and connections shall be measured in inches.

2.7 DRIVE SYSTEM

A. Materials and Construction

1. Shall be factory installed and totally enclosed in a NEMA 4X, (IP66) wash-down enclosure. Capable of operating on any input power from 110VAC to 240VAC, 60 Hz single phase supply without user configuration or selection switches.
2. Motor
   a. Reversible, brushless DC gear motor rated for continuous duty, with overload protection.
   b. The maximum gear motor RPM shall be 125 RPM.
3. Enclosure

a. Bottom housing shall be pressure cast aluminum with acidic liquid iron phosphate three-stage clean and coat pretreatment and exterior grade corrosion resistant polyester polyurethane powder coat.
b. Top housing shall be structural foam molded Noryl engineered thermoplastic.
c. Rated NEMA 4X (IP66).
d. Provided with 316SS floor/shelf level mounting brackets and hardware.
e. M12 receptacles shall be located at the rear of the pump for input and output signals.

4. Rear connections
   a. RJ45 receptacle shall be located at the rear of the pump for use with EtherNet/IP and Modbus TCP/IP.
   b. One M12 receptacle shall be located at the rear of the pump for use with Profibus.
5. Control Circuitry
   a. All control circuitries shall be integral to the pump and capable of adjusting the pump motor speed from 0.01% to 100.0% in 0.01% increments less than 10% motor speed, in 0.01% and in 0.1% increments greater than 10% motor speed (10,000:1 turndown ratio).
   b. The pump output shall be capable of being manually controlled via front panel touchscreen.
   c. The pump output shall be capable of being remotely controlled via 4-20mA analog input.
   d. The pump output shall be capable of being remotely controlled via TTL/CMOS digital high-speed pulse type input and an AC sine wave type pulse input in the range of 0 to 1,000 Hz. The frequency resolution shall be 1 Hz.0
   e. The pump output shall be capable of being remotely controlled via pulse triggered batching.
      i. Range of 1 to 9,000 pulses per batch.
      ii. Adjustable from 1 to 500,000 seconds.
   f. The pump output shall be capable of being controlled via EtherNet/IP, Modbus TCP/IP, or Profibus DP.

6. Local Control: Front panel touchscreen for stop/start, configuration menu access and navigation, operating mode selection, display options selection, tube info data, and reverse direction.
7. Display: Multi-color LCD touchscreen for menu driven configuration settings, pump output value, service alerts, tube failure detection (TFD) system and flow verification system (FVS) alarms status, remote input signal values, tubing life timer value. Display color shall be green when indicating run operation, blue when in idle, yellow when in stand-by, and red to indicate an alarm condition exists.
8. Remote Inputs
    a. Provide for remote stop/start pump via non-powered contact closure loop.
    b. Provide for remote priming via non-powered contact closure loop
9. Control Methods – Provide for:
    a. Secondary start/stop input via non-powered contact closure.
    b. Alternate control methods including: Dispensing Mode, Cycle Adjust Mode, and Time-Of-Day Mode.
10. Outputs: User selectable 4-20mA and 0-1,000Hz output signal which are scalable and proportional to pump output volume.
11. Alarms:
    a. Four (4) contact closure alarm outputs (three low-power and one high-power)
    b. Each alarm output shall be assignable to monitor any of the following pump functions: TFD system, FVS system, motor run/stop, motor failed to respond to commands, motor is running in reverse, general alarm (TFD, FVS, and/or motor over current), input signal failure, output signal failure, remote/local control status, revolution counter (tube life) set-point, or monitor which of the nine different pump operating modes is currently active.

12. Provide a six-digit password protected configuration menu.

13. Provide a flow verification system with programmable alarm delay time from 1-1000 seconds. FVS system shall monitor the FVS flow sensor while pump is running only. System shall not monitor pump while not running.

2.8 FLOW VERIFICATION SENSOR

A. Shall output high-speed digital pulse signal or 4-20 mA, while pump is running only, to verify chemical injection.

B. Flow verification sensor shall be an ultrasonic transit time sensor.

C. Materials and Construction

1. Wetted components shall be PVDF, PEEK, and TFE/P, or engineer approved equal.
2. End fittings shall be PVDF with optional PVC slip fittings. All are included.
3. Sensor operating range shall be capable of handling project required flow rates.
4. Shall provide a scalable 4-20 mA sourcing output.
5. Shall provide a scalable 0-1,000 Hz open collector frequency output
6. Shall provide a programmable Form C Solid State Relay rated for a maximum load capacity of 24 VDC and 100 mA.
7. Programmable for high/low flow rate alarm.
8. Programmable to energize on specified flow total.
9. Power Requirements: 5 VDC; 5 Watts maximum.
10. Shall be certified to NSF Standard 61 Drinking Water System Components.
11. Accuracy shall be +/- 0.75% full scale. Accuracy shall be +/- 0.25% at the field calibrated setpoint.

2.9 Safety

A. The pump shall be certified to NSF Standard 61 Drinking Water System Components, UL standard 778 motor operated pump and CSA standard C22.2 process control equipment.

B. Manufactured to ISO 9001:2015 requirements and processes.

C. Tube Failure Detection (TFD) system sensors shall be wholly located in the pump head. TFD system will stop the pump within three seconds of leak detection. To prevent false alarms due to rain, wash-down, condensation, etc., tube failure detection system shall not trigger with water contact. Process fluid waste ports or leak drains shall not be provided.

D. Pump head cover shall include an imbedded magnetic safety interlock which will stop the pump when removed. Pump rotor speed shall be limited to 6 RPM when cover is removed.

E. Secondary user confirmation input required for motor reversal, tube life revolution count reset, and factory default configuration reset.

2.10 CHEMICAL FEED PANEL AND ACCESSORIES

A. Pre-Fabricated Wall Mounted Chemical Feed Panels:

1. All accessories to be provided pre-mounted and pre-plumbed on floor/ mounted chemical feed panels.
2. Provide chemical resistant polypropylene chemical feed panel and stands as shown on the Contract Drawings.
3. Materials of construction:
   a. Materials of construction shall be as recommended, unless specifically stated herein, by the pump manufacturer for compatibility with the chemical and its suitability with the specified chemical's environment.
   b. Skid and shelves: Polypropylene sheet: 3/4-inch thick minimum
   c. Hardware: 304SS
4. Unions: shall be provided for easy pump removal
   a. Material: Schedule 80 CPVC
5. Pump shelves: sized to fit metering pump and all other accessories
6. Entire chemical feed system shall be securely mounted and pre-piped using Schedule 80 CPVC to form a complete and integrated system.
7. Accessories shall be oriented to facilitate operation and maintenance.

B. Supply the following accessories, in the quantities indicated on the Contract Drawings for the metering pumps per the materials listed in the chart below.

Chemical	Material	Size	Elastomers	Seats
Sodium Hypochlorite	CPVC/Noryl	½"	Viton	TFE

C. Piping

1. 1" Inlet and ½" outlet CPVC Schedule 80

D. Tubing

1. Reinforced braided PVC, or PTFE if required by Owner
    a. Contractor to confirm
2. Certified NSF 61

E. Y-Strainer

1. Provide Y-strainer on suction pipe
    a. Acceptable Manufacturers as recommended by the pump manufacturer for the compatibility with chemical and system.
    b. Seal: Viton
    c. Strainer: 20-mesh

F. Pressure Relief Valve/Backpressure Valve:

1. Acceptable Manufacturers as recommended by the pump manufacturer for the compatibility with chemical and system.
2. In line design suitable for service flow and pressure as specified. To be provided by chemical metering pump supplier and preset to the metering pump manufacturer's recommendations.
3. All materials in contact with the process fluid shall be chemically compatible with the specified fluid.
4. Pressure range: 10 – 150 psi minimum
    a. Pressure setting to be externally adjustable
5. A union shall be installed on both sides for ease of removal.
6. Inlet and Outlet connections: True-Union type
7. Pressure relief valve piped to suction header is required at minimum.

G. Calibration Column:

1. Acceptable Manufacturers as recommended by the pump manufacturer for the compatibility with chemical and system.
2. Provide (1) calibration column for each chemical service.
    a. Clear cylinder with graduations marked.
    b. (1) isolation ball valve per calibration column
    c. Column top cap connection: threaded with vent

d. Size: One-minute draw-down calibration at pump maximum capacity

H. Pulsation Dampener

1. Acceptable Manufacturers as recommended by the pump manufacturer for the compatibility with chemical.
2. Size: Selected by the metering pump manufacturer to match the capacity of the pump.
3. Pulsation dampener shall be provided with an isolation ball valve.

I. Ball Valves:

1. Quantity required shall be determined from the Drawings.
2. Acceptable Manufacturers as recommended by the pump manufacturer for the compatibility with chemical.
3. Material:
   a. CPVC
   b. All materials in contact with the process fluid shall be chemically compatible with the specified fluid.
4. Working pressure: 100 psi
5. Design:
   a. True union design, with unions on both ends (double union design)
   b. Ends: socket
   c. Body: full-unrestricted circular inlet and outlet with diameter equal to rated size of valve
   d. Ball valves shall have Viton seats and seals.
   e. Vented

J. Check Valves

1. Acceptable Manufacturers as recommended by the pump manufacturer for the compatibility with chemical.
2. Cracking pressure = 1.0 psi
3. Material:
   a. CPVC
   b. All materials in contact with the process fluid shall be chemically compatible with the specified fluid.

K. Pressure Gauges:

1. Acceptable Manufacturers as recommended by the pump manufacturer for the compatibility with chemical.

2. Material shall be suitable for the intended service environment.
3. Pressure range and reading: 0-200psi
4. With Guard
5. Diaphragm seal of compatible materials (including fill media)

L. Pressure Switch:

1. Acceptable Manufacturers as recommended by the pump manufacturer for the compatibility with chemical.
2. Material:
   a. 316SS
   b. Shall be suitable for the intended service environment.
3. With Guard

M. Flow Indicator

1. Acceptable Manufacturers as recommended by the pump manufacturer for the compatibility with chemical.
2. All materials in contact with the process fluid shall be chemically compatible with the specified fluid.
3. Indicator: Floating or moving element clearly visible through body to confirm flow.
4. Connections: Union type

N. Flow Sensor

1. Acceptable model and manufacturer:
   a. MS6, by Blue-White
   b. Or Engineer Approved Equal.
2. All materials in contact with the process fluid shall be chemically compatible with the specified fluid.
3. Available Flow Ranges: 10–10,000 ml/min
4. Provide outputs compatible with pump control system

2.11 ANCHORS

A. Each stand shall be designed to provide for being secured to a wall.

B. Manufacturer shall provide anchor bolt design, in accordance with seismic design criteria in the main facility structural general notes and sealed by an Arizona PE.

C. Contractor shall provide equipment anchors in accordance with shop drawings.

2.12 Spare Parts

A. Provide to the Owner for each chemical metering skid a suggested spare parts list to maintain the equipment in service for the first 2 years of normal operation. Include one (1) parts list for all serviceable components. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

B. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

PART 3 -– EXCECUTION

3.1 Installation

A. The pump system shall be installed in accordance with the manufacturer's instructions. All installation personnel shall be trained and qualified in the areas of plumbing, electrical work, and instrumentation as required to complete the installation.

3.2 Testing

A. The unit will be factory assembled, inspected and factory run tested prior to shipment. The Engineer and/or Owner may, at their option and own expense, witness the factory test. Supplier shall notify contractor 2 weeks prior to factory test to allow for attendance. Before shipping the equipment, the manufacturer shall perform shop tests. These tests shall include at a minimum:

1. Visual inspection of all equipment.
2. Complete assembly, start-up, and "wet-test" of feed pumps.

B. Upon completion of installation, Manufacturer shall field test the installed equipment to demonstrate compliance with performance requirements as specified.

3.3 INITIAL START-UP AND TRAINING

A. The manufacturer shall provide a written start-up plan typical with similar installations with a sample report from a previous installation.

B. The supplier shall provide the services of a manufacturer-authorized and trained service technician who shall adequately inspect the installation, test the equipment furnished, confirm the performance of the equipment, and instruct the Owner's operating personnel in its maintenance and operation. Manufacturer's sales representatives are not deemed acceptable to provide the start-up service.

1. The services of the technician shall be provided as follows:
    a. Technician services to be coordinated with dewatering screw press system services.
    b. Training shall consist of a combination of classroom and field training as detailed in specification Section 017900.
    c. Manufacturer shall provide a written field test / start-up report after completion of testing.

3.4 Warranty

A. The manufacturer shall warrant their equipment shall be free from manufacturing defects in materials and workmanship and that it will modify, replace or repair for a period of period twelve (12) months from acceptance or eighteen (18) months from shipment, whichever occurs first, from date of substantial completion.

SECTION 400500
GENERAL PIPING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the general requirements for selecting piping materials, miscellaneous piping items and installation, testing and disinfection guidelines. This section applies to pipe diameters less than 4 inch. Further details are provided in the material-specific specification sections.

B. Related Sections:

1. Submittals in Section 013300.
2. Water Piping Systems in Section 02550.
3. Sewer Line Construction in Section 02560.
4. Pipe Installation in Section 02535.
5. Plumbing Piping in Division 22.
6. Pipe Couplings and Expansion Joints in Section 400506.
7. Pipe Hangers and Supports in Section 400507.
8. Wall Pipes, Floor Pipes, and Pipe Sleeves in Section 400509.
9. Thermoplastic Process Pipe in Section 400531.
10. Process Valves in Section 400551.
11. Equipment, Piping, Duct, and Valve Identification in Section 400775.

1.2 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC).

B. American Iron and Steel Institute (AISI).

C. American National Standards Institute (ANSI).

D. American Society of Mechanical Engineers (ASME).

E. American Society for Testing and Materials (ASTM).

F. American Water Works Association (AWWA).

G. American Welding Society (AWS).

H. American Welding Society Code (WSC).

I. The Society for Protective Coatings (SSPC).

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submittal information shall include at least the following, as applicable:

1. Manufacturer's catalog information for the pipe, joints, fittings and other materials showing that they conform to the requirements of the pipe specifications.
2. Manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings and joints are used.
3. Materials list and affidavit of, or manufacturer's certification of, compliance with referenced standards (e.g., AWWA, ANSI, ASTM, etc.).
4. Coatings.
5. Certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.
6. Manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations, including manufacturer's recommended torques for tightening bolts.
7. Number, size, and material of construction of tie rods and lugs for each thrust harness on the project.
8. Manufacturer's data sheets for joint and fitting details.
9. Show deflections at push-on and mechanical joints.
10. Show piping service (chemical, water, air, etc.).
11. Show wall thickness of pipe and fittings.
12. Show fitting dimensions.
13. Show lining thickness and lining certification showing it meets required specification.

1.4 QUALITY ASSURANCE

A. The materials covered by these specifications are intended to be standard materials of proven reliability and as manufactured by a reputable manufacturer who has experience in the production of piping materials. The materials furnished shall be designed and constructed in

accordance with the best practices and methods and shall function satisfactorily when installed as shown on the Contract Drawings and per the manufacturer's recommendations.

1.5 DELIVERY, STORAGE AND HANDLING OF EQUIPMENT

A. The Contractor shall store and temporarily support materials prior to installation in strict accordance with the Manufacturer's recommendations and instructions. Protect all exposed surfaces.

B. The materials shall be handled in strict accordance with the instructions of the Manufacturer.

C. Protect the materials from being contaminated by dust, dirt, vibration and moisture. Store off ground.

D. Protect thermoplastic material from UV exposure and excessive heat.

E. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

1.6 DEFINITIONS

A. Buried piping is piping buried in the soil, commencing at the wall or beneath the slab of a structure.

1. Where a coating is specified, provide the coating up to the structure wall. Unless detailed otherwise, coating shall penetrate wall no less than 1 inch.
2. Piping encased in concrete is considered to be buried; however, do not coat encased pipe.

B. Exposed piping is piping in any of the following conditions or locations:

1. Above ground.
2. Inside buildings, vaults, or other structures.
3. In underground concrete trenches or galleries.

C. Submerged piping is piping in any of the following conditions or locations:

1. In tanks, with the potential to be splashed or covered by water.

PART 2 - MATERIALS

2.1 MATERIALS SELECTION

A. Materials called out in the drawings or specified for a specific piece of equipment shall govern over materials stated in the piping schedule. Any

alternative materials must be approved by the Engineer. If no material is shown in the drawings or specified in an equipment specification, use the following piping materials:

Service	Location	Size Range	Pipe Material	
			Gravity Flow	**Pressure Pipe**
Liquid, Water[1] / Wastewater	Buried	3" and smaller	CPVC Schedule 80, 304 SS Schedule 10	CPVC Schedule 80, 304 SS Schedule 10, Copper[2]
		4" and larger	See Water Piping Systems in Section 02550.	
	Exposed	3" and smaller	304 SS Schedule 10	304 SS Schedule 10, Copper[2]
		4" and larger	See Water Piping Systems in Section 02550.	
	Submerged	3" and smaller	CPVC Schedule 80, 304 SS Schedule 10	CPVC Schedule 80, 304 SS Schedule 10
		4" and larger	See Water Piping Systems in Section 02550.	
Process Air	All	All	N/A	304 SS Schedule 10
Foul Air	All	All	N/A	FRP
Liquid (Wet) Chlorine (Sodium hypochlorite)	All	All	N/A	CPVC Schedule 80 (solvent-welded)

1. Potable Water (PW) piping must meet NSF 61 standards.
2. Copper piping is an option for potable water only.
3. Lining of Ductile Iron Pipe to be epoxy for all wastewater and sludge applications upstream of the secondary effluent.

2.2 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

B. Indicate field measurements on Shop Drawings.

2.3 BOLTS AND NUTS

A. Provide the appropriate bolt and nut material to match the pipe material, installation location, process, and function, as described in each pipe material specification section.

B. Lubricant for Stainless Steel Bolts and Nuts shall be chloride-free and shall be Dynatex Anti-Seize Lubricating Compound No. 49560, Huskey Specialty Lubricants Lube O'Seal or equal.

2.4 GASKETS

A. Provide the appropriate gasket type and material to match the pipe material, installation location, process, and function, as described in each pipe material specification section.

2.5 THREAD FORMING FOR STAINLESS STEEL BOLTS

A. Form threads by means of rolling, not cutting or grinding.

2.6 FLANGE INSULATION KITS

A. Flange insulation kits shall consist of an insulating gasket, an insulating stud sleeve for each bolt, insulating washers for each bolt, and a steel washer between each insulating washer and the nut. The sleeves shall be one piece, integral with the insulating washer. Gaskets shall be full face. Provide double sleeve and washer sets for each bolt.

B. Gasket material shall be phenolic, 1/8 inch thick. The flange insulating gasket shall be full diameter of the flange with a nitrile O-ring on each side of the gasket. Dielectric strength shall be not less than 500 volts per mil and a compressive strength of not less than 24,000 psi.

C. Insulating flange bolt sleeves shall be high-density polyethylene or spiral-wrapped mylar. Dielectric strength shall be not less than 1,200 volts per mil.

D. Insulating flange bolt washers shall be high-strength phenolic a minimum thickness of 1/8 inch. Dielectric strength shall be not less than 500 volts per mil and a compressive strength of not less than 25,000 psi.

E. Steel flange bolt washers for placement over the insulating washers shall be a minimum thickness of 1/8 inch and be cadmium plated.

F. Flange insulation kits shall be as manufactured by Central Plastics Company, Advance Product Systems, or engineer-approved alternative.

G. Polyurethane sealant shall be compatible with materials and fluid.

2.7 INSULATING UNIONS

A. Insulating unions shall consist of a molded nylon sealing sleeve mounted in a three-piece malleable-iron (ASTM A47 or A197) body. Ends shall be threaded (ASME B1.20.1) when connecting to steel piping and copper solder joint when connecting to copper piping. Minimum working pressure shall be 150 psi. Unions shall be as manufactured by Central Plastics Company, Capital Insulation, or equal.

PART 3 - EXECUTION

3.1 INSTALLING PIPE SPOOLS IN CONCRETE

A. Install pipes or pipe sleeves in walls and slabs before placing concrete. See Concrete Division 03 and Wall Pipes, Floor Pipes and Pipe Sleeves in Section 400509.

3.2 RAISED FACE AND FLAT FACE FLANGES

A. Where a raised face flange connects to a flat-faced flange, remove the raised face of the flange.

3.3 INSTALLING ABOVE-GROUND, EXPOSED, OR SUBMERGED PIPING

A. Provide pipe hangers and supports as detailed in the drawings and as specified in Section 400507.

B. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

3.4 INSTALLING FLANGED PIPING

A. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

B. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

C. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

D. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.

E. Do not use more than one gasket between contact faces in assembling a flanged joint.

F. Tighten the bolts to the manufacturer’s specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

G. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

3.5 INSTALLING BLIND FLANGES

A. At outlets not indicated to be connected to valves or to other pipes and to complete the installed pipeline hydrostatic test, provide blind flanges with bolts, nuts, and gaskets.

B. Coat the inside face of blind flanges per Painting and Coating in Section 09900.

3.6 INSTALLING GROOVED-END PIPING

A. Install grooved-end pipe and fittings in accordance with the coupling manufacturer's recommendations and the following.

B. Clean loose scale, rust, oil, grease, and dirt from the pipe or fitting groove before installing coupling. Apply the coupling manufacturer's gasket lubricant to the gasket exterior including lips, pipe ends, and housing interiors.

C. Fasten coupling alternately and evenly until coupling halves are seated. Use torques as recommended by the coupling manufacturer.

D. Provide separate hangers and supports at both sides of flexible joints per Section 400506.

3.7 INSTALLATION OF STAINLESS-STEEL BOLTS AND NUTS

A. Prior to assembly, coat threaded portions of stainless-steel bolts and nuts with lubricant.

3.8 PIPE TESTING AND INSPECTION

A. Flushing and cleaning – see Section 02535.

B. Hydrostatic testing – see Section 02535.

C. Air testing – see Section 02535.

D. Contractor to submit qualifications of all field welders, with experience related directly to the methods and materials to be used. See welding and inspection requirements in each material-specific section.

****END OF SECTION****

SECTION 400507
PIPE HANGERS AND SUPPORTS

PART 1 -GENERAL

1.1 DESCRIPTION

A. This section includes materials and installation of pipe hangers and supports including accessory items, such as anchor bolts and screws, and neoprene isolation pads.

B. Related Sections:

1. Submittals in Section 013300.
2. Painting and Coating in Section 09900.
3. General Piping Requirements in Section 400500.
4. Flexible Pipe Couplings and Expansion Joints in Section 400506.
5. Wall Pipes, Floor Pipes, and Pipe Sleeves in Section 400509.
6. Thermoplastic Process Pipe in Section 400531.
7. Process Valves in Section 400551.

1.2 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC).

B. American Iron and Steel Institute (AISI).

C. American National Standards Institute (ANSI).

D. American Society of Mechanical Engineers (ASME).

E. American Society for Testing and Materials (ASTM).

F. American Water Works Association (AWWA).

G. American Welding Society (AWS).

H. American Welding Society Code (WSC).

I. Manufacturers Standardization Society (MSS).

J. The Society for Protective Coatings (SSPC).

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submittal information shall include at least the following, as applicable:

1. Provide line drawings of each piping system to the scale shown in the drawings, locating each brace and support or hanger. Identify

each type of brace, hanger or support by the manufacturer's catalog number or figure.

2. Provide installation drawings and manufacturer's catalog information on each type of brace, hanger, and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.

1.4 QUALITY ASSURANCE

A. The materials covered by these specifications are intended to be standard materials of proven reliability and as manufactured by a reputable manufacturer having experience in the production of pipe hangers and supports or the materials used in custom-designed supports. The materials furnished shall be designed and constructed in accordance with the best practices and methods and shall function satisfactorily when installed as shown on the Contract Drawings and per the manufacturer's recommendations.

1.5 DELIVERY, STORAGE AND HANDLING OF EQUIPMENT

A. The Contractor shall store and temporarily support materials prior to installation in strict accordance with the Manufacturer's recommendations and instructions. Protect all exposed surfaces.

B. Protect the materials from being contaminated by dust, dirt, vibration and moisture. Store off ground.

C. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

PART 2 -MATERIALS

2.1 DESIGN CRITERIA

A. Not all pipe supports or hangers required are shown in the drawings. Provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.

B. Pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water), plus valve actuators and any insulation, and shall have a minimum safety factor of five based on the material's ultimate strength.

2.2 HANGER AND SUPPORT SYSTEMS

A. Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, B-Line, Superstrut, or equal.

B. Pipe hangers and supports shall comply with MSS SP-58 for the standard types referenced in the drawings. Construct special hangers and supports if detailed in the drawings. Type numbers for standard hangers and supports shall be in accordance with MSS SP-58 as listed below:

Type Number	Description	Manufacturer and Model (or Equal)
1	Adjustable FRP clevis	Anvil Fig. 590 or 260, B-Line B3100 or B3102
3	FRP double-bolt pipe clamp	Anvil Fig. 295A or 295H, B-Line B3144 or B3144A
4	FRP pipe clamp (pipes smaller than 3 inches)	Anvil Fig. 212, B-Line B3140
5	Pipe hanger	B-Line B6690
6	Adjustable swivel pipe ring	Anvil Superstrut 714, Anvil Fig. 104
7	Adjustable FRP band hanger	B-Line B3172
8	Extension pipe or riser clamp	Anvil Fig. 261, B-Line B5573
9	Adjustable band hanger	Anvil Fig. 97
10	Adjustable swivel ring band hanger	Anvil Fig. 70, B-Line B3170 NF
11	Split pipe ring with adjustable turnbuckle	Anvil Fig. 108, B-Line B3173
13	FRP turnbuckle	Anvil Fig. 230, B-Line B3202
14	FRP clevis	Anvil Fig. 299, B-Line B3201
15	Swivel turnbuckle	Anvil Fig. 114, B-Line B3224
16	MalleableFRP socket	Anvil Fig. 110R, B-Line B3222
17	FRP weldless eye nut	B-Line B3200
18	FRP concrete insert	Anvil Fig. 281, Superstrut 452
19	Top beam C-clamp	Anvil Fig. 92, B-Line B3033
20	Side I-beam or channel clamp	Anvil Fig. 14 or 217
21	Center I-beam clamp	Anvil Figure 134
22	Welded attachment type	Anvil Fig. 66 B-Line B3083

Type Number	Description	Manufacturer and Model (or Equal)
23	C-clamp	Anvil Fig. 86, B-Line B3036L
24	U-bolt	Anvil Fig. 137, B-Line B3188
26	Clip	Anvil Fig. 262, B-Line B3180
28	FRPwide flange or I-Beam	Anvil Fig. 228 clamp with eye nut
30	FRP beam clamp with extension piece	Superstrut CM-754, B-Line B3054
31	Light welded steel bracket	Anvil Fig. 194, B-Line B3063
32	Medium welded steel bracket	Anvil Fig. 195, B-Line B3066
33	Heavy welded steel bracket	Anvil Fig. 199, B-Line B3067
34	Side beam bracket	Anvil Fig. 202, B-Line B3062
36	Pipe saddle support	Anvil Fig. 258, B-Line B3095
37	Pipe stanchion saddle	Anvil Fig. 259, B-Line B3090
38	Adjustable pipe saddle support	Anvil Fig. 264, B-Line B3089
39	Steel pipe covering	Anvil Fig. 160, 161, 162, 163, 164, or 165; Superstrut A 789; B-Line B3160/B3165
40	Insulation protection shield	Anvil Fig. 167, B-Line B3151
41	Single pipe roll	Anvil Fig. 171, B Line B3114
43	Adjustable roller hanger with swivel	Anvil Fig. 181, B Line B3110
44	Pipe roll, complete	Anvil Fig. 271, B Line B3117SL

C. Pipe supports shall be Fiber-Reinforced Polymer (FRP) material in any submerged or corrosive locations.

1. Pipe supports inside the sodium hypochlorite storage/feed building shall be FRP material to resist the corrosive environment.

D. Hanger rods shall be of the same material as the support or hanger.

2.3 OFFSET PIPE CLAMP

A. Anvil Figure 103 or equal. Material shall be Fiber-Reinforced Steel (FRP).

2.4 MISCELLANEOUS PIPE SUPPORTS AND HANGERS

A. Pipe Anchor Chair: Anvil Figure 198 or equal.

B. One Hole Clamp: Anvil Figure 126 or equal.

2.5 FRP CHANNEL FRAMING SYSTEM

A. FRP pipe hangers and supports shall be Aickinstrut, Inc., or equal.

B. Material properties shall be as follows:

Longitudinal Direction	
Ultimate Tensile (psi)	35,000 minimum
Ultimate Compressive (psi)	35,000 minimum
Ultimate Flexural (psi)	35,000 minimum
Tensile Modulus (psi)	3.0×10^6 minimum
Flexural Modulus (psi)	2.0×10^6 minimum
Ultimate Shear Strength (psi)	(6,000 minimum
Izod Impact (ASTM D256) ft-lb/inch notch	30 minimum
Transverse Direction	
Ultimate Tensile (psi)	10,000 minimum
Ultimate Compressive (psi)	20,000 minimum
Ultimate Flexural (psi)	14,000 minimum
Tensile Modulus (psi)	1.0×10^6 minimum
Compressive Modulus (psi)	1.4×10^6 minimum
Flexural Modulus (psi)	1.0×10^6 minimum
Ultimate Shear Strength (psi)	5,500 minimum
Ultimate Bearing Stress (psi)	35,000 minimum
Izod Impact, ft-lb notch	5 minimum
Hardness	
Barcol Test	50 minimum

C. Glass fiber reinforced composites and plastic products shall have a flame spread rating of 25 or less when tested per ASTM E84.

D. Channel framing shall be 1 5/8 inches deep by 1 5/8 inches wide and shall be made using vinylester resin equal to Derakane 411, Ashland Hetron 922, or Reichhold Dion 9800. It shall have a nexus polyester surfacing veil over 100% of the surface which, along with a filler system, will protect against degradation from ultraviolet light. Channel shall be supplied with integral notches 1 inch on center. Notches shall be located on the interior flange to prevent slippage of pipe clamps and fittings

after installation. In place of notched channel, unnotched channel may be used if the vertical channel sections supporting the horizontal piping are provided with stop lock hardware at each pipe clamp to prevent slippage. Channel framing shall be Aickinstrut G.R.P. Type V 200 series or equal.

E. Channel framing connections shall be made with vinylester glass fiber composite nuts, bolts, all threaded rods, channel fittings, bases, and hanger assemblies. Nuts, bolts, and rods shall be Aickinstrut 4200 series, Strut Tech PVCG, or equal. Channel fittings shall be grooved, Aickinstrut 2800 style or equal.

F. Load-bearing pipe clamps and nonload-bearing pipe straps shall be nonmetallic and nonconductive and shall be made by the injection molding process using polyurethane base resin. Pipe clamps and straps shall be Aickinstrut 3100 series or equal.

G. Clevis hangers shall be made with vinylester glass fiber and be Aickinstrut 1500 series or equal.

H. Hanger rods for trapezes shall be FRP.

2.6 ANCHOR BOLTS AND SCREWS

A. Anchor bolts and screws for attaching pipe supports and hangers to walls, floors, ceilings, and roof beams shall be Type 316 stainless steel, ASTM A276 or F593. Nuts shall be Type 316 stainless steel, ASTM A194, Grade 8M or ASTM F594, Type 316 stainless steel.

B. Anchor bolts inside sodium hypochlorite storage/feed building shall be isolated from direct chemical spray or vapor with FRP shrouds, sleeves, or coating.

PART 3 - EXECUTION

3.1 PIPE BRACING

A. All piping runs and systems shall be braced per MSS SP-127, as required per the structural Seismic Design Category, and the following.

B. Pipe supports utilizing hanger rods greater than 12 inches long, and those that do not include saddles or clamps at the piping, shall not be considered to provide either lateral or longitudinal bracing. Lateral bracing must be provided to these systems at least every second support. Longitudinal bracing must be provided on each run that utilizes these supports.

C. Pipe supports that do not utilize clamps to the piping shall not be considered to provide longitudinal bracing. Longitudinal bracing must be provided on each run that utilizes these supports.

D. Longitudinal bracing may be provided by lateral bracing on an adjacent run, provided that the lateral bracing is no more that 2-feet or 3-times the nominal pipe diameter (whichever is greater) from the centerline of the longitudinal pipe.

E. Expansion and contraction of piping systems shall be considered when designing and locating braces. Bracing shall not adversely affect the thermal movement of the piping system.

F. Piping systems incorporating vibration isolation and control devices may not be braced with rigid braces that would transmit the vibration to the building structure.

G. Braces, where required, shall be installed at or as close as practical to a hanger location.

H. Except for cable braces, the slenderness ratio (l/r) shall not exceed 200, where "l" is the effective length of the brace and "r" is the least radius of gyration. Rod stiffeners shall be used on hanger rods at brace locations as necessary to ensure that this requirement is met.

I. When cables are used for braces, they shall oppose each other in order to provide bracing for forces acting 180 degrees apart. Cables shall be tightened to remove slack. In the case of a lateral or longitudinal (traverse) only seismic brace, this will be two (2) independent cables. In the case of a four-way brace, this will be four (4) independent cables.

J. The last length of braced pipe shall be provided with a lateral brace at the end of the run.

K. Single C-type clamps, including top beam clamps such as ANSI/MSS SP-58 Types 19 and 23, with or without restraining straps, shall not be used to attach braces to the building structure.

L. Bracing materials in sodium hypochlorite storage/feed areas shall be FRP or Type 316 stainless steel only.

3.2 PIPE HANGERS AND SUPPORTS

A. All piping runs and systems shall be supported per MSS SP-58 and the following.

B. Hangers or supports shall be provided within one pipe diameter of:

1. Attachment to pumps or other equipment,
2. Each side of expansion joints and flexible couplings, and

3. Each side of FRP valves 6" and larger.

C. Hangers or supports shall be provided within 3 pipe diameters or 2-feet (whichever is greater) of each change in direction.

D. On straight runs, hangers or supports shall be provided within the following spacings:

Nominal Pipe or Tube Size (Inches)	Maximum support or hanger spacing (feet)					Minimum[2] Hanger Rod Size, (Inches)
	Carbon Steel, Std Wt.	Stainless Steel, Sch 10	DIP[1]	Copper	Plastic	
≤ 3/8	7	8	8	5	3.5	3/8
½	7	8	8	5	4	3/8
3/4	7	9	9	5	4	3/8
1	7	9	9	6	4.5	3/8
1¼	7	9	9	7	5	3/8
1½	9	12	12	8	5	3/8
2	10	13	13	8	5	3/8
2½	11	14	14	9	6	1/2
3	12	15	15	10	6	1/2
4	13	17	17	11	6.5	5/8
6	16	21	20	13	7.0	3/4
8	19	24	20	16	8	3/4
10	22	26	20	18	8.5	7/8
12	23	30	20	19	9.5	7/8
14	25	32	20	-	10	1
16	27	35	20	-	10	1
18	28	37	20	-	11	1
20	30	39	20	-	11.5	1¼
24	32	42	20	-	12.5	1¼
36	35	46	20	-	-	1¼

1. DIP to be supported with a minimum of 1 support per length of pipe, and at changes in direction and branch connections.
2. Rods greater than 3/8" may be reduced one size for double-rod hangers.

E. Supports and hangers inside sodium hypochlorite storage and feed buildings shall be FRP or 316 stainless steel.

F. For piping runs in PVC conduit outside of buildings, supports may be FRP, 316 stainless steel, or PVC-coated hangers/clamps as indicated in this Section.

3.3 INSTALLING PIPE HANGERS AND SUPPORTS

A. Adjust pipe hangers per MSS SP-58.

B. Install leveling bolts beneath support baseplates. Provide 1½-inch thick grout pad beneath each base.

C. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

D. Isolate stainless steel supports from direct contact with PVC or FRP piping using elastomer or plastic isolators per manufacturer's recommendations.

3.4 INSTALLING FRP CHANNEL FRAMES

A. Use 1-5/8-inch-high channel frames unless 3-1/4-inch is needed to provide clearance from walls. Use multiple back-to-back channels if additional clearance is needed.

B. Seal the ends of cut FRP channel frames with the channel manufacturer's sealant or resin.

3.5 PAINTING AND COATING

A. Paint exposed pipe hangers and supports to match the color of the adjacent wall per Section 09900. If the adjacent wall is not painted, paint the hangers and supports to match color code of the largest pipe on the support.

B. Coat submerged pipe hangers and supports per Section 09900.

****END OF SECTION****

SECTION 400509
WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes materials, installation, and testing of wall pipes and sleeves (including wall collars and seepage rings) and penetrations.

B. Related Sections:

1. Submittals in Section 013300.
2. Quality Control and Quality Assurance in Section 014400.
3. Concrete Work in Division 03.
4. Painting and Coating in Section 09900.
5. General Piping Requirements in Section 400500.

1.2 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC).

B. American Iron and Steel Institute (AISI).

C. American National Standards Institute (ANSI).

D. American Society of Mechanical Engineers (ASME).

E. American Society for Testing and Materials (ASTM).

F. American Water Works Association (AWWA).

G. American Welding Society (AWS).

H. The Society for Protective Coatings (SSPC).

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submittal information shall include at least the following, as applicable:

1. Detail drawings for fabricated wall and floor pipes and sleeves, wall flanges, seep rings, and sealing materials. Show dimensions and wall thicknesses.
2. Show flange sizes and the appropriate ANSI or AWWA flange dimensional standard where flanged end wall pipes or penetrations are used.

3. Show grooved-end dimensions and AWWA grooved-end dimensional standard where grooved-end wall pipes or penetrations are used.

4. List coating systems to be applied, manufacturer, and dry thickness of coatings. Call out coatings where coatings are to be applied.

5. List materials of construction, with ASTM material reference and grade.

6. Submit manufacturer's instructions for installing rubber annular hydrostatic sealing devices.

1.4 QUALITY ASSURANCE

A. Follow requirements in the General Piping Requirements in Section 400500.

1.5 DELIVERY, STORAGE AND HANDLING OF EQUIPMENT

A. Follow requirements in the General Piping Requirements in Section 400500.

PART 2 - MATERIALS

2.1 GENERAL

A. Follow all appropriate guidance and requirements, including but not limited to submittals and definitions under General Piping Requirements in Section 400500.

B. Flanges are to be flat face.

C. Flanges shall match the flange on the connecting pipe.

D. See specification section for the specific pipe material for flange bolts and gaskets.

2.2 RUBBER ANNULAR HYDROSTATIC SEALING DEVICES

A. Rubber annular hydrostatic sealing devices shall be of the modular mechanical type, utilizing interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Assemble links to form a continuous rubber belt around the pipe, with a pressure plate under each bolt head and nut.

B. Materials of construction shall be as follows:

Compound	Material
Pressure plate	Reinforced nylon polymer
Bolts and nuts for links	316 stainless steel
Sealing element	Viton

C. The size of the wall sleeve needed to accommodate the passing pipe shall be as recommended by the rubber annular seal manufacturer.

D. Provide centering blocks in 25% of the sealing elements on pipelines larger than 12 inches in diameter.

E. The rubber annular hydrostatic sealing devices shall be Link-Seal® as manufactured by Garlock; Innerlynx as manufactured by Advance Products & Systems, Inc.; or approved equal.

2.3 BOLTS, NUTS, AND GASKETS FOR FLANGED-END WALL PIPES

A. See specification section for the specific pipe material for flange bolts, nuts and gaskets.

2.4 POLYETHYLENE FOAM FILLER FOR PIPE PENETRATIONS

A. Packing foam shall be an extruded closed-cell polyethylene foam rod, such as Minicell backer rod, manufactured by Industrial Systems Department; Ethafoam, as manufactured by Dow Chemical Company, or equal.

B. The rod shall be 1/2 inch larger in diameter than the annular space.

2.5 POLYURETHANE SEALANT FOR PIPE PENETRATIONS

A. Sealant shall be multipart, polyurethane sealant, to cure at ambient temperature, for continuous immersion in water. Install as recommended by the manufacturer.

B. Products: SIKA Sikaflex 2C or equal.

2.6 PAINTING AND COATING

A. Line and coat sleeves and pipes (except stainless steel) per Section 09900.

PART 3 - EXECUTION

3.1 LOCATION OF PIPES AND SLEEVES

A. Provide a wall or floor pipe where shown in the drawings and wherever piping passes through walls or floors of tanks or channels in which the water surface is above the pipe penetration.

B. Provide a floor sleeve where shown in the drawings and wherever plastic pipe, steel, or stainless-steel pipe 3 inches and smaller or Virgin PTFE tubing passes through a floor or slab. Provide a rubber annular sealing device in the annular space between the sleeve and the passing pipe or tubing.

C. Provide wall sleeves where shown in the drawings and wherever plastic, steel or stainless-steel pipe 3 inches and smaller, or Virgin PTFE tubing passes through a wall. Provide a single rubber annular seal when the wall is 8 inches thick or less. Provide two rubber annular seals (one at each end of the sleeve) when the wall is more than 8 inches thick. Pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

D. Where wall sleeves are installed such that water or soil is on one or both sides of the channel or wall, provide two rubber annular seals (one at each end of the sleeve).

E. Where pipes pass through walls or slabs and no sleeves or wall or floor pipe with seep ring is provided, pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

3.2 INSTALLATION IN EXISTING CONCRETE WALLS AND SLABS

A. Core drill holes as shown on drawings or sufficiently larger in diameter than the outside diameter of the wall flange or collar for use with a rubber annular seal. Install wall pipe and collar assembly axially aligned with the piping to which it will be connected or will contain. Install a rubber annular sealing device in the annular space between the cored opening and the wall pipe, per manufacturer's instructions.

B. Pack the void space between the pipe and concrete with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

3.3 INSTALLATION IN NEW CONCRETE WALLS AND SLABS

A. Install wall pipes and sleeves in walls before placing concrete. Do not allow any portion of the pipe or sleeve to touch any of the reinforcing steel. Install wall pipe or sleeve and collar assembly axially aligned with the piping to which it will be attached or will contain. Provide supports to prevent the pipe or sleeve from displacing or deforming while the concrete is being poured and is curing.

3.4 INSTALLATION IN DRY FLOORS AND SLABS

A. Install pipe sleeves and spools in concrete floors and slabs that do not have water over them such that the sleeve or pipe extends from the bottom of the floor or slab to 2 inches above the floor or slab unless shown otherwise in the drawings.

3.5 INSTALLATION OF WALL PIPES HAVING FLANGED END CONNECTIONS

A. Check alignment before grouting in place or pouring concrete. Realign if the sleeve is not properly aligned.

B. Install flanged end wall sleeves or penetrations with bolt holes of the end flanges straddling the horizontal and vertical centerlines of the sleeve.

3.6 QUALIFICATIONS OF WELDERS

A. Welder qualifications shall be in accordance with AWS D1.1.

3.7 INSTALLATION OF RUBBER ANNULAR HYDROSTATIC SEALING DEVICES

A. Install in accordance with the manufacturer's instructions.

3.8 FIELD TESTING

A. Check each wall penetration for leakage at the time the hydraulic structure is tested for leakage; see Section 033000. Penetrations shall show zero leakage.

END OF SECTION

SECTION 400531

THERMOPLASTIC PROCESS PIPE

PART 1 -GENERAL

1.1 DESCRIPTION

A. This section includes materials, installation, and testing of thermoplastic pipe and fittings for plant process piping systems and includes PVC, CPVC, and Virgin PTFE for chemical tubing.

B. Related Sections:

1. Submittals in Section 013300.
2. Trench Excavation And Backfill in Section 02300.
3. Pipe Installation in Section 02535.
4. Water Piping Systems in Section 02550.
5. Sewer Line Construction in Section 02560.
6. General Piping Requirements in Section 400500.
7. Pipe Couplings and Expansion Joints in Section 400506.
8. Pipe Hangers and Supports in Section 400507.
9. Wall Pipes, Floor Pipes, and Pipe Sleeves in Section 400509.
10. Process Valves in Section 400551.
11. Equipment, Piping, Duct, and Valve Identification in Section 400775.

1.2 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM).

B. American Water Works Association (AWWA).

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Provide submittal information per General Piping Requirements in Section 400500.

C. Additional submittal information shall include at least the following:

1. Submit data sheets for solvent cement demonstrating ASTM compliance. Include manufacturer's recommended method of installing solvent.

1.4 QUALITY ASSURANCE

A. Follow requirements in the General Piping Requirements in Section 400500.

1.5 DELIVERY, STORAGE AND HANDLING OF EQUIPMENT

A. Follow requirements in the General Piping Requirements in Section 400500.

B. When the pipe is received, visually inspect to verify that the correct product was received. Check for damage that may have occurred during transit. Examine for fractures, kinking, deep gouges, or cuts. Remove pipe with gouges or cuts in excess of 10% of the pipe wall thickness.

C. Cover pipe 100% with protective coverings or tarpaulins to prevent deposition of road salts, diesel smoke, fuel residue, and other contaminants in transit.

D. Hook lifting equipment, such as cranes, extension boom cranes, and side boom tractors, to wide web choker slings that are secured around the load or to lifting lugs on the component. Use only wide web slings. Do not use wire rope slings and chains which can damage components. Use spreader bars when lifting pipe or components longer than 20 feet.

E. Unload large fabrications using a wide web choker sling and lifting equipment such as an extension boom crane, crane, or lifting boom. Do not use stub outs, outlets, or fittings as lifting points, and avoid placing slings where they will bear against outlets or fittings.

F. Protect the pipe from stones and sharp objects.

G. Store fittings in their original cartons.

PART 2 - MATERIALS

2.1 GENERAL

A. Follow all appropriate guidance and requirements, including but not limited to submittals, definitions, and insulation under General Piping Requirements in Section 400500.

2.2 PIPE SCHEDULE

A. See Contract Drawings and Section 400500.

2.3 PVC SCHEDULE 40/80 PIPE

A. Pipe shall be Schedule 40 or Schedule 80, per piping schedule and Contract Drawings, Type I, Grade 1 (Class 12454-B), conforming to ASTM D1784 and D1785.

B. Fittings and Joints:

1. Pipe and fitting joints shall be socket welded, except for piping 3" and smaller, which may be threaded, and for all sizes where flanged joints are required to connect to valves and equipment or transition to other pipe materials.
2. Socket-type shall conform to ASTM D2466 (Schedule 40) or ASTM D2467 (Schedule 80).
3. Threaded fittings shall conform to ASTM D2464.
4. PVC flanges shall be of the one-piece solid socket design and shall be made of the same material as the pipe. Pressure rating shall be at least 150 psi at a temperature of 73°F. Minimum burst pressure shall be 500 psi. Flanges shall match the dimensions of ASME B16.5, Class 150 steel flanges for outside diameter, bolt circle, and bolt holes.

2.4 CPVC SCHEDULE 40/80 PIPE

A. Pipe shall be Schedule 40 or Schedule 80, per piping schedule and contract drawings, Type IV, Grade 1 (Class 23447), conforming to ASTM D1784 and F441/F441M.

B. CPVC shall be used in place of PVC on piping installed outside.

C. Fittings and Joints:

1. Pipe and fitting joints shall be socket welded, except for piping 3" and smaller, which may be threaded, and for all sizes where flanged joints are required to connect to valves and equipment or transition to other pipe materials.
2. Socket-type shall conform to ASTM F438 (Schedule 40) or ASTM F439 (Schedule 80).
3. Threaded fittings (Schedule 80) shall conform to ASTM F439.
4. CPVC flanges shall be of the one-piece solid socket design and shall be made of the same material as the pipe. Pressure rating shall be at least 150 psi at a temperature of 73°F. Minimum burst pressure shall be 500 psi. Flanges shall match the dimensions of ASME B16.5, Class 150 steel flanges for outside diameter, bolt circle, and bolt holes.

2.5 VIRGIN PTFE PROCESS TUBING

A. Provide Polytetrafluoroethylene (PTFE), ½-inch inner diameter size suitable for continuous service with sodium hypochlorite 12.5%.

B. Tubing shall be manufactured from 100% virgin unpigmented resin material and be chemically resistant and flexible, conforming to ASTM D4894.

C. Tubing shall be one continuous length for installation.

D. Color: Clear

E. Fittings and Joints:

1. Tube fittings and joints are to be of the compression type utilizing a ferrule nut provided. The material must be compatible with the chemical fluid.
2. Rigid PVC Pipe-to-PE tubing transition fittings shall be solvent cement socket by compression or single barb fittings with stainless steel clamps.

F. Flexible tubing runs shall include strain relief supports and be protected from UV exposure.

G. Certification: NSF/ANSI 61 for potable water contact, where required.

H. Installation

1. Route tubing to avoid kinks and sharp bends; minimum bend radius per manufacturer.
2. Support tubing at intervals per manufacturer's recommendations to prevent sagging.
3. Protect tubing from mechanical damage and direct sunlight.

2.6 SOLVENT CEMENT

A. Solvent cement for socket joints shall comply with ASTM D2564 and F656.

2.7 BOLTS AND NUTS FOR FLANGES

A. Bolts and nuts for buried flanges and flanges located indoors, outdoors above ground, and in vaults and structures, except as specified in paragraph 2 below, shall be carbon steel, ASTM A307, Grade B, hot-dipped galvanized per ASTM F2329.

B. Bolts and nuts for submerged flanges and flanges located within any corrosive or humid environments, including all basins, shall be Type 304 stainless steel conforming to ASTM A193, Grade B8 for bolts and ASTM A194, Grade 8 for nuts.

C. Glands, bolts, and gaskets to be used with HDPE Pipe shall be manufactured in accordance with AWWA C153. Bolts and nuts shall be grade 2 or higher.

D. Bolts for piping in sodium hypochlorite service shall be made of titanium, per ASTM F467, Grade Ti1 or Ti7. Nuts shall conform to ASTM F467, same material as the bolts.

E. Provide a washer under each nut and under each bolt head. Washers shall be of the same material as the nuts.

2.8 GASKETS FOR FLANGES

A. Gaskets for flanged joints shall be full faced, 1/8-inch thick, having a hardness of 50 to 70 durometer A. Gasket material for other than sodium hypochlorite service shall be EPDM or EPR. Gasket material for sodium hypochlorite service shall be Viton ETP.

2.9 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

A. See General Piping Requirements Section 400500.

PART 3 - EXECUTION

3.1 GENERAL

A. Do not install PVC or CPVC pipe when the temperature is below 40°F or above 90°F. Store loose pipes on racks with a maximum support spacing of 3 feet. Provide shades for pipe stored outdoors or installed outdoors until the pipe is filled with water.

B. Ship, store, and place PVC, CPVC and Virgin PTFE pipe at the installation site, supporting the pipe uniformly. Avoid scratching the pipe surface. Do not stack higher than 4 feet or per manufacturer's recommendations or with weight on bells. Cover to protect from sunlight.

C. Store tubing and all pipe fittings indoors in their original cartons. Do not store near sources of heat, or where they may be exposed to sunlight. Cover to protect from fluorescent or mercury lamps.

D. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements that have exceeded the shelf life marked on the storage container.

E. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section of pipe.

F. Before installation, check tubing for correct material and size, and inspect for damage, kinks, cracks, cuts, or other visible defects. Do not use material with any sign of nonconformance.

G. Do not drag PVC/CPVC/VPTFE pipe over the ground, drop it onto the ground, or drop objects on it.

3.2 INSTALLING SOLVENT-WELDED JOINTS

A. Bonding requirements shall be in accordance with the bonding procedure specification (BPS) as in ASME B31.3 (2006 edition), Chapter VII, Part 9. Bonding for this project shall include solvent welding or cementing.

B. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air at the same temperature conditions as the pipe for at least one hour.

C. Cut pipe ends square and remove burrs, chips, and filings before joining pipe or fittings. Bevel pipe ends as recommended by the pipe manufacturer in the BPS.

D. Wipe away loose dirt and moisture from the inside and outside diameters of the pipe end and the inside diameter of the fitting before applying solvent cement. Clean the surfaces of both pipes and fittings that are to be solvent welded with a clean cloth moistened with acetone or methylethyl ketone. Do not apply solvent cement to wet surfaces.

E. The pipe and fitting socket shall have an interference fit. Perform a dry fit test at each joint before applying solvent cement. The pipe shall enter the fitting socket between one-third and two-thirds of the full socket depth when assembled by hand.

F. Make field solvent-welded joints only by qualified personnel and/or in the presence of the pipe manufacturer's representative who shall instruct and advise the Contractor's personnel in the assembly of the joints. Joint bonding shall be done in accordance with a BPS established by the pipe manufacturer. Qualification of the BPS shall be in accordance with ASME B31.3, Chapter VII, Part 9, paragraphs A328.2 through A328.5. Each person who will perform bonding shall be qualified in executing the BPS per paragraph A328.2.5.

G. Make up solvent-welded joints per ASTM D2855, F493 and the BPS. Application of cement to both surfaces to be joined and assembly of these surfaces shall produce a continuous bond between them with visual evidence of cement at least flush with the outer end of the fitting bore around the entire joint perimeter.

H. Allow at least eight hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.

I. After completion of the solvent-welded joints, subject the piping system to a hydrostatic test pressure per Section 02535. Remove solvent-welded joints that show excessive leakage and assemble new joints.

J. Acceptance criteria for solvent-welded joints shall be as follows:

Kind of Imperfection	**Solvent Cemented**
Unfilled areas in joint	None permitted
Unbonded areas in joint	None permitted
Protrusion of material into pipe bore, % of pipe wall thickness	Cement, 50%

3.3 ASSEMBLING THREADED JOINTS

A. Cut threaded ends on CPVC or PVC to the dimensions of the ASTM F1498. Ends shall be square cut. Follow the pipe manufacturer's recommendations regarding pipe hold-down methods, saw cutting blade size, and saw cutting speed. Gauges, gauge tolerances, and gauging procedures shall comply with ASTM F1498, Sections 7 and 8. Perform field gauging on every field-cut threaded connection.

B. Pipe or tubing cutters shall be specifically designed for use on PVC and CPVC pipe.

C. If a hold-down vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to avoid scratching the pipe.

D. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.

E. Apply Teflon® thread compound or Teflon® tape lubricant to threads before screwing on the fitting.

F. Per ASTM F1498, paragraph 4.8, when assembling metal and plastic threads together, the preferred method is plastic external threads to metal internal threads. Cyclic heating and cooling may result in dripping leaks. Overtightening of internal threads will produce hoop stresses greater than plastic can withstand, resulting in split fittings.

G. Assemble threaded flanges and fittings per ASTM F1498, Sections 4, 7, and 8. Do not tighten threaded connections more than two turns past finger tightness for both internal and external threads.

3.4 INSTALLING FLANGED JOINTS

A. Lubricate bolt threads with graphite and oil before installation.

B. Tighten bolts on PVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages and the final torque values per manufacturer's recommendation.

3.5 INSTALLING STAINLESS STEEL BOLTS AND NUTS

A. See Section 400500.

3.6 INSTALLING ABOVEGROUND AND EXPOSED PIPING

A. See Section 400500.

B. Fill empty piping with water, provide temporary shading, or other means to keep the surface temperature of the pipe below 100°F.

3.7 WRAPPING FITTINGS AND RESTRAINED JOINT DEVICES

A. Wrap buried cast-iron fittings and restrained joint devices with polyethylene per Section 404616.

3.8 FINAL HYDROSTATIC TESTING

A. Perform final hydrostatic testing for leakage in accordance with Section 02535 after all joints have been tested and defective joints have been repaired or replaced.

3.9 DISINFECTION

A. Perform disinfection for potable water piping in accordance with Section 02550.

3.10 PAINTING AND COATING

A. Coat piping per Section 09900.

END OF SECTION

SECTION 400551

PROCESS VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes materials, testing, and installation of check valves, and process valves including ball valves and diaphragm valves quick connect couplings, service saddles, and tapping sleeves. This section also includes information about manual actuators.

B. Related Sections:

1. Submittals in Section 013300.
2. General Equipment Provisions and Installation in Section 016100.
3. Equipment and System Start-up and Performance Testing in Section 017516.
4. Spare Parts and Maintenance Materials in Section 017843.
5. General Piping Requirements in Section 400500.
6. Equipment, Piping, Duct, and Valve Identification in Section 400775.
7. Electrical work and instrumentation, except as otherwise specified herein, is included in Divisions 16, 26, and 40.

1.2 REFERENCE STANDARDS

A. American Gear Manufacturers Association (AGMA).

B. American Iron and Steel Institute (AISI).

C. American Society for Testing and Materials (ASTM).

D. American Water Works Association (AWWA).

E. Copper Development Association (CDA).

F. SAE International (SAE).

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submittal information shall also include the following, as applicable:

1. Port sizes, including actual area of port as a percentage of the area as calculated for the nominal valve size.

2. Maximum torque required to open and close each actuated valve. Provide calculations for actuator torque.

3. For backflow preventers, provide the following certifications and approvals:

   a. Manufacturer's certificate of compliance with AWWA C511 for backflow preventers.

   b. Manufacturer's certificate of compliance with NSF 61.

   c. Manufacturer's certification that materials are lead free.

   d. Certificate of backflow preventer test by a certified tester to Owner for Approval.

4. Motor/pneumatic actuator dimensions and weights and coatings.

5. Location of internal stops for gear actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter. State differential pressure and fluid velocity used to size actuators.

6. Certified factory performance test records of electric motor and pneumatic actuators.

7. Motor data including nameplate data, insulation type, duty rating, and torque output at duty rating.

8. Electrical schematic drawings and wiring diagrams showing physical locations of components of electric motor actuators.

1.4 OPERATION AND MAINTENANCE MANUALS

A. Submit operations and maintenance manuals in accordance with Section 01330.

1.5 QUALITY ASSURANCE

A. The materials covered by these specifications are intended to be standard materials of proven reliability and as manufactured by a reputable manufacturer having experience in the production of valves, actuators, and related materials.

B. The materials furnished shall be designed and constructed in accordance with the best practices and methods and shall function satisfactorily when installed as shown on the Drawings and per the manufacturer’s recommendations.

C. The equipment manufacturer must have experience in the manufacture, operation, and servicing of valves, actuators and appurtenances of

similar performance and reliability to that specified with installations in satisfactory operations for at least 5 years.

1.6 DELIVERY, STORAGE AND HANDLING OF EQUIPMENT

A. The Contractor shall store and temporarily support materials prior to installation in strict accordance with the Manufacturer's recommendations and instructions. Protect all exposed surfaces.

B. Protect the materials from being contaminated by dust, dirt, vibration and moisture. Store off ground.

C. Protect thermoplastic material from UV exposure and excessive heat.

D. The materials shall be handled in strict accordance with the instructions of the Manufacturer.

E. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

PART 2 - MATERIALS

2.1 GENERAL

A. Valves are identified in the drawings by size, valve type and actuator type.

B. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.

C. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

D. Motor actuators shall have the name of the manufacturer cast or molded onto the actuator body or shown on a permanently attached plate in raised letters.

E. Actuators are to be compatible with the valve and are to be correctly sized.

F. For buried locations, valves with mechanical joint ends may be substituted for flanged ends specified provided the mechanical joint ends are compatible with the pipe ends.

2.2 VALVES

A. Ball Valves:

1. Full Port Threaded Bronze Ball Valves 2 Inches and Smaller:

a. Ball valves for air or water service shall have a pressure rating of at least 600 psi WOG at a temperature of 100°F with full port ball and body design.

b. Valves shall comply with MSS SP-110. Provide bronze (ASTM B62 or ASTM B584, Alloy C83600 or C84400) body and plug ball retainer. Ball and stem shall be Type 316 stainless steel.

c. Valves shall have threaded ends (ASME B1.20.1), non-blowout stems, reinforced Teflon seats, and have plastic-coated lever actuators.

d. Valves shall be Stockham T-285 Series, Apollo 77C-140 Series, or equal.

2. Bronze Ball/Corporation Stops, 2 Inches and Smaller, for Water Service:

a. Corporation stops shall be bronze (ASTM B62 or ASTM B584, Alloy C83600) with male inlet iron pipe threads and female outlet iron pipe threads and shall conform to AWWA C800.

b. Minimum pressure rating shall be 300 psi. Stops shall have an outlet fitting to adapt from iron pipe thread to copper tubing.

c. Stops shall be Ford Ballcorp Type FB 1700, James Jones E-1931, or equal.

3. Double Union CPVC Ball Valves 3 Inches and Smaller, for use with polymer and chemical systems, as appropriate:

a. CPVC ball valves for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F and rated at a pressure of 100 psi at a temperature of 150°F.

b. Body, ball, and stem shall be CPVC conforming to ASTM D1784, Type 4, Grade 1. Seats shall be Teflon. O-ring seals shall be EPDM.

c. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation.

d. Valves for use with potable water must be certified to meet NSF 61 requirements.

e. Valves shall be as manufactured by Chemtrol, Hayward, Spears Manufacturing Company, Plast-O-Matic, IPEX Series VKD, or equal.

4. Double Union CPVC Ball Valves 3 Inches and Smaller with Vented Ball for use with sodium hypochlorite chemical feed system:

a. Vented CPVC ball valves for chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F and rated at a pressure of 85 psi at a temperature of 140°F.

b. Provide machined vent hole, deburred, in the ball to allow gases to vent.

c. Body, ball, and stem shall be CPVC conforming to ASTM D1784, Type 4, Grade 1. Seats shall be Viton. O-ring seals shall be Viton.

d. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation.

e. Valves shall be Hayward, Plast-O-Matic "Z-MBV-Vent," Asahi/America Type 21, or equal.

B. Check Valves:

1. CPVC Ball Check Valves, 3 Inches and Smaller:

a. Valves shall be constructed CPVC per ASTM D1785, Type IV, Grade 1. Ends shall be double union, socket welded. Seats and seals shall be EPDM.

b. Valves shall have a pressure rating of 150 psi at a temperature of 73°F.

2. CPVC Swing Check Valves, 6 Inches and Smaller:

a. Swing check valves 6 inches and smaller shall be constructed of CPVC per ASTM D1785, Type IV, Grade 1. Ends shall be flanged, ASME B16.5, Class 150. Seats and seals shall be Viton. Provide bolted bonnet. Valves shall have a pressure rating of 100 to 150 psi at a temperature of 73°F.

3. Valves to be Spears, Hayward or approved equal.

C. Diaphragm Valves:

1. CPVC Diaphragm Valves, 3 Inches and Smaller:

   a. Valves shall be constructed CPVC per ASTM D1785, Type IV, Grade 1. Ends shall be double union, socket welded. Seats and seals shall be Viton or Engineer Approved alternative.

   b. Valves shall have a pressure rating of 150 psi at a temperature of 73°F.

2. Valves to be Spears, Hayward or approved equal

2.3 QUICK-CONNECT COUPLINGS

A. Quick-connect couplings 3/4 inch through 3 inches shall be female coupler/female or male thread. Bodies shall be polypropylene. Cam lever and pins shall be Type 304 stainless steel.

B. Quick-connect couplings larger than 3" shall be female coupler, ASME B16.1 Class 125 flange with locking handles. Bodies and locking handles shall be Type 316 stainless steel.

C. Gasket shall be EPDM or Buna-N. Pressure rating shall be at least 125 psi at 70°F and at least 70 psi at 150°F. Provide quick-connect dust plug with security chain for each coupling.

2.4 BOLTS AND NUTS FOR FLANGED VALVES

A. Bolts and nuts for flanged valves shall be as described in Section 400500 and the specification section(s) for the corresponding pipe/valve material(s).

2.5 GASKETS FOR FLANGES

A. Gaskets for flanged end valves shall be as described in Section 400500 and the specification section(s) for the corresponding pipe/valve material(s).

2.6 PAINTING AND COATING

A. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 09900. Apply the specified prime, intermediate, and finish coats at the place of manufacture. Touch up paint as needed in the field after installation. Coat handwheels the same as the valves.

B. Coat isolation valves the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 09900. Apply the specified prime, intermediate, and finish coats at the place of

manufacture. Touch up paint as needed in the field after installation of the valve.

C. Measure the thickness of the valve interior linings per Section 09900. Repair areas having insufficient film thickness per Section 09900.

2.7 PACKING, O-RINGS, AND GASKETS

A. Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following non-asbestos materials:

1. Viton
2. PTFE
3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.
4. Buna-N (nitrile).

2.8 RUBBER SEATS

A. Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/L in the fluid conveyed.

2.9 MANUAL VALVE ACTUATORS

A. Provide lever or wrench actuators for exposed valves 8 inches and smaller. For larger valves, provide handwheels.

B. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.

C. Provide 2-inch AWWA operating nuts for buried and submerged valves.

D. Design gear actuators assuming that the differential pressure across the disc is equal to the pressure rating of the valve and assuming a fluid velocity of 16 fps for valves in liquid service and 80 fps for valves in air or gas service and a line fluid temperature range of 33°F to 125°F for liquid service and up to 250°F for air services, unless otherwise required in the detailed valve specifications. Size actuators using a minimum safety factor of 1.5 for valves in open/close service and 2.0 in modulating service.

E. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

F. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

G. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

PART 3 -EXECUTION

3.1 STORAGE AND TEMPORARY INSTALLATION BEFORE START-UP

A. If actuators are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Provide temporary covers over the actuator electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Exercise each actuator from its fully open to fully closed position at least once every 30 days. Inspect electrical contacts before start-up.

3.2 JOINTS

A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached.

B. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

C. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

D. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

3.3 INSTALLING EXPOSED VALVES

A. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.

B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.4 INSTALLING DIAPHRAGM VALVES

A. Install such that the pinch of the diaphragm is about a horizontal axis.

B. Install such that the diaphragm opens fully and the compressor stores in the top when the valve is open.

C. Orient the valve such that the seat is opposite the high-pressure side.

3.5 INSTALLATION OF BACKFLOW PREVENTERS

A. After installation, testing shall be done by an installer tester certified by Arizona Department of Environmental Quality (ADEQ).

3.6 INSTALLING EXTENSION STEM GUIDE BRACKETS

A. Install extension stem guide bracket at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

3.7 INSTALLING TAPPING SLEEVES AND SERVICE SADDLES

A. Position tapping sleeves in correct alignment, so that no rotation is required. Check sleeve neck to make certain that the gasket is properly seated and not protruding where tapping cutter may damage it. Tighten bolts to the torque recommended by the manufacturer.

B. Install service saddles with the gaskets seated on the pipe so that zero leakage is obtained. Tighten bolts to the torque recommended by the manufacturer.

3.8 FIELD INSTALLATION OF ACTUATORS

A. Install the valve and actuator as indicated in the Drawings in accordance with the manufacturer's instructions. Keep units dry, closed, and sealed to prevent internal moisture damage during construction.

B. Provide additional hangers and supports for actuators which are not mounted vertically over the valve or which may impose an eccentric load on the piping system.

3.9 VALVE LEAKAGE TESTING

A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 02535 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test.

B. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

3.10 VALVE FIELD TESTING

A. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

B. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

C. Electric and pneumatic actuators shall be tested to verify the satisfactory operation and performance of each actuator. Each valve shall be opened and closed using the plant control system as applicable (Auto), or modulated (pneumatic), and manually.

D. Pressure test the backflow preventers along with the connecting piping per Section 02535. There shall be no visible leaks in the backflow preventer assembly, valves, or joints of the interconnecting piping.

3.11 WARRANTY

A. The manufacturer shall warrant that their valves shall be free from manufacturing defects in materials and workmanship and that it will modify, replace or repair, within twelve (12) months from date of startup or eighteen (18) months from delivery, whichever comes first.

****END OF SECTION****

SECTION 400775

EQUIPMENT, PIPING, DUCT, AND VALVE IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes materials and installation of markers, labels, and signs for pipes, ducts, valves, mechanical equipment, hazardous materials warnings, and miscellaneous plant services.

B. Related Sections:

1. Submittals in Section 013300.
2. Equipment and System Start-up and Performance Testing in Section 017516.
3. General Piping Requirements in Section 400500.
4. Process Valves in Section 400551.

1.2 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA).

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submittal information shall include at least the following, as applicable:

1. Submit manufacturer's catalog data and descriptive literature describing materials, colors, letter size, and size of labels.

1.4 QUALITY ASSURANCE

A. The materials covered by these specifications are intended to be standard materials of proven reliability and as manufactured by a reputable manufacturer having experience in the production of identification and tags. The materials furnished shall be designed and constructed in accordance with the best practices and methods and shall function satisfactorily when installed as shown on the Contract Drawings and per the manufacturer’s recommendations.

1.5 DELIVERY, STORAGE AND HANDLING OF EQUIPMENT

A. The Contractor shall store and temporarily support materials prior to installation in strict accordance with the Manufacturer’s recommendations and instructions.

B. Protect the materials from being contaminated by dust, dirt, vibration and moisture.

C. Protect thermoplastic material from UV exposure and excessive heat.

PART 2 -MATERIALS

2.1 LABELS FOR EXPOSED VALVES

A. Provide an identification tag for each valve, minimum 2 inches and larger, unless otherwise noted.

B. Tag is to be 2-inch-square or circular 316 stainless or 1/16-inch-thick laminated fiberglass to be chemically resistant to an indoor environment with sodium hypochlorite.

C. Tags shall have black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings.

D. Acceptable manufacturers: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal.

2.2 HOSE BIBB SIGNS - UNSAFE WATER OR CHEMICAL USE

A. Provide a rigid sign labeled per Owner and local code requirements for each hose bibb utilizing non-potable water. Size and lettering shall conform to OSHA requirements.

B. Signs shall be weather- and chemical-resistant, minimum 7 x 3 inches.

C. Acceptable manufacturers: Seton Nameplate Company 20-gauge baked enamel, minimum size 7 inches by 3 inches; Brady B-120 Fiber-Shield fiberglass, minimum size 7 inches by 3 inches, 1/8 inch thick; or equal.

2.3 LABELS FOR MECHANICAL EQUIPMENT

A. Provide identification labels for each pump, tank, or other piece of mechanical equipment.

B. Label to show the equipment name and be 1 1/2 inches (minimum) by 4 inches (minimum)

C. Materials: 316 stainless or 1/16-inch-thick laminated fiberglass to be chemically resistant to an indoor environment with sodium hypochlorite.

1. Brass and aluminum tags are not recommended in chemical areas.

D. Tag shall show the equipment tag number and/or name or designation as given in the drawings.

E. Secure labels with stainless steel hardware or adhesive suitable for the mounting surface.

F. Acceptable manufacturers: Brady B-120 Fiber-Shield, Seton Style 2065, or equal.

2.4 LABELS FOR EXPOSED TANKS

A. Provide a sign on each tank bearing the tank tag number and the name of the liquid stored.

B. Minimum size shall be 7 inches by 10 inches.

C. Acceptable manufacturers: Brady B-946, Seton Name Plate Corporation PSPL, or equal.

2.5 HAZARDOUS MATERIALS WARNING AND DANGER SIGNS

A. Provide hazardous materials warning diamond signs complying with NFPA 704.

B. Size shall be 10 inches square.

C. Wall signs shall be 1/8-inch-thick fiberglass. Provide Brady B-120 Fiber-Shield or equal.

D. Signs attached to tanks, cabinets, or pieces of equipment shall be self-adhesive vinyl cloth. Provide Brady B-946 or equal.

E. Provide signs reading "DANGER" followed by the name of the chemical, gas, or hazard.

1. Size shall be 10 inches by 14 inches.
2. Signs shall be 1/8-inch-thick fiberglass. Provide Brady B-120 or equal.

PART 3 -EXECUTION

3.1 INSTALLING VALVE AND EQUIPMENT LABELS

A. Attach labels to valves and equipment using 316 stainless steel chains, wire, or self-locking cable ties suitable for the service environment. Adhesive-backed tags may be used only where mechanical fastening is not feasible.

B. Attach valve labels to the valve handwheels. If the valve has no handwheel, attach the label to the valve by tying the tag wire, chain, or approved fastener around the operating shaft or nut.

C. Ensure labels are installed in a visible location, oriented for easy reading, and free of sharp edges or protrusions.

3.2 INSTALLING MISCELLANEOUS SIGNS

A. Attach per sign manufacturer's recommendations and per OSHA requirements.

B. Ensure signs are plumb, level, and clearly visible from normal approach paths.

3.3 FIELD QUALITY CONTROL

A. After installation, Contractor shall prepare and submit a Valve, Equipment, and Signage Schedule documenting the following:

1. Location of each valve, equipment item, and tank with installed identification tag or sign.
2. Tag number, name, and service designation as shown on the Drawings and coordinated with P&ID schedules.
3. Type of label or sign installed, including material and size.
    a. Engineer and Owner will review the schedule against the Drawings and visually inspect the installation for compliance with these Specifications.
    b. Contractor shall correct missing, incorrect, or improperly installed tags and signs at no additional cost to the Owner.

****END OF SECTION****

SECTION 434143

CHEMICAL STORAGE TANKS

PART 1 - GENERAL

1.1 Summary

A. Description of the Work

1. Furnish and install two (2) chemical storage tanks as shown on the Drawings and as specified herein, including all labor materials, equipment and incidentals required for a complete installation.
2. The specification shall cover high-density linear polyethylene (HDLPE) tanks for above-ground chemical storage service. Chemical storage tanks shall be single walled construction, designed for the specific chemical.

B. Related Work Specified Elsewhere

1. Submittals in Section 01330.
2. Equipment and Materials in Section 01600.
3. Equipment and System Start-up and Performance Testing in Section 017516.
4. Spare Parts and Maintenance Materials in Section 017843.
5. Demonstration and Training in Section 017900.
6. Process Valves in Section 400551.
7. Equipment, Piping, Duct, and Valve Identification in Section 400775.
8. Electrical work and instrumentation, except as otherwise specified herein, is included in Divisions 16, 26, and 40.

1.2 Reference Standards

A. American Society of Mechanical Engineers (ASME).
B. American National Standards Institute (ANSI).
C. American Society for Testing and Materials (ASTM).
D. American Water Works Association (AWWA).
E. International Standards Organization (ISO).
F. National Electrical Manufacturers Association (NEMA).
G. Occupational Health and Safety Association (OSHA).
H. Underwriters Laboratories, Inc. (UL)

1.3 Submittals

A. Submit shop drawings in accordance with Section 01330.

B. Tank submittals shall also include the following:

1. Chemical resistance of material and service conditions.
2. Drawings to include mounting brackets, knuckle radii, nozzle locations and orientations, and nozzle and gasket construction, including sizing and description of all fittings and accessories.
3. Instructions for installation.
4. Design calculations for structural and seismic design of tie-down lugs (number, size, and embedment length of anchor bolts) signed and sealed by a structural engineer registered.
5. Manufacturer's certification that tank construction complies with ASTM D1998 per these specifications.

C. Submit complete operations and maintenance manuals in accordance with Section 01330.

1.4 Quality Assurance

A. Manufacturer Quality Assurance

1. The materials covered by these specifications are intended to be standard materials of proven reliability and as manufactured by a reputable manufacturer having experience in the production of chemical storage tanks of the type specified and appurtenances.
2. The equipment shall be designed and constructed in accordance with the best practices and methods and shall function satisfactorily when installed as shown on the Drawings and per the manufacturer's recommendations.
3. The equipment manufacturer must have experience in the manufacture, operation, and servicing of chemical storage tanks of similar performance and reliability to that specified with installations in satisfactory operations for at least 5 years.

1.5 Delivery, Storage, and Handling

A. The chemical storage tanks shall be factory assembled and tested prior to delivery and shall be delivered to the site fully assembled,

except where partial disassembly is required by transportation regulations or for protection of components.

B. Manufacturer shall follow ASTM D1998 for shipments, wrapping tanks with protective polyethylene sheet and protective tarpaulins to prevent deposition of road salts, fuel residue and other contaminants in transit. Cover or plug fittings and flanges faces with weatherproof metal covers.

C. The Contractor shall store and temporarily support materials prior to installation in strict accordance with the Manufacturer's recommendations and instructions.

D. Protect the equipment from being contaminated by dust, dirt, vibration and moisture. Store off ground.

E. The equipment shall be installed and lubricated in strict accordance with the instructions of the Manufacturer.

F. Protect thermoplastic material from UV exposure and excessive heat.

G. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

PART 2 - MATERIALS

2.1 GENERAL

A. The chemical storage tanks are to be vertical, flat-bottomed, single-walled tanks, with domed top, lifting lugs, and fittings as shown in the Drawings.

B. Each tank shall be provided with a plant specific identification tag or tags as shown elsewhere in this specification. The text size shall conform to mechanical equipment identification tagging requirements as in Section 400775.

C. Stainless steel nameplates shall be attached to the tank providing as a minimum, the plant specific identification tag, the manufacturer's model and serial number, rated capacity, and all pertinent data.

2.2 DESIGN REQUIREMENTS

A. The tank shall be a single-wall, cylindrical, vertical storage vessel manufactured by rotational molding in one-piece seamless construction.

B. Tanks are to be designed for above-ground, vertical installation and for containing chemicals at atmospheric pressure and temperature.

C. Tanks shall meet ASTM D1998 requirements.

D. The chemical storage tanks shall be designed for the following operating conditions and shall meet the following performance criteria.

Parameter	**Value**
Installation Location	Inside new masonry chemical building
Chemical Stored	12.5% NaOCl
Specific Gravity Rating	1.5
Minimum Capacity per Tank	5,000 gallon
Maximum Temperature	120°F
Number of Tanks	2

1. The approximate dimensions of the tank shall be 102-inches in diameter and 136-inches straight wall vertical height.

E. Equipment Tag Number

1. TNK-101
2. TNK-201

2.3 Acceptable Model and Manufacturer

A. Peabody Engineering, platinum level

B. Snyder-Crown Industries, ProTank, Poly Processing Company, Rotational Molding, Nalgene, or approved equal.

C. Engineer-approved alternative.

2.4 Materials and Construction

A. Tanks shall be constructed of high-density linear polyethylene (HDLPE) (ASTM D1998, Type II).

B. Resin material shall contain an ultraviolet (UV 15) stabilizer as compounded by the resin manufacturer. Pigament shall not exceed 0.25% (dry blended) of the total weight.

C. All materials in contact with the process fluid shall be chemically compatible with the specified fluid.

D. All tank fittings shall be spin welded or approved equal. Spin welding shall be per the tank manufacturer's qualified procedure.

E. Gasket materials (where used) apply only to external, non-penetrating joints.

1. Material: Viton.

2.5 Fittings

A. General Requirements

1. Locate all fittings at least 6-inches away from tank radius and flange lines.
2. Where a spin-welded flange adapter is provided for external bolted connections, orientation of flange fittings shall have bolt holes straddling the principal centerline of the tank in accordance with ANSI/AMSE B16.5.
3. Flange dimensions to conform to ASME B16.5, Class 150. Flanges shall be flat faced and sit minimum 4-6 inches from the tank shell.

B. Tank wall thickness at all fused penetrations shall conform to manufacturer's recommendations and ASTM D1998 limitations. Reinforcement shall be provided where required by the manufacturer for nozzle size and location.

C. Fittings shall be sized per manufacturer's standard tables and rated for full tank hydrostatic head.

D. Provide spin welded fittings and adapters for instrument/service ports above the liquid level sized as shown on the Drawings.

E. Provide spin welded flange adapter or socket couplings for all below-liquid connections. Threaded fittings are not permitted below liquid level.

F. External Mating Hardware (Outside shell only)

1. External bolted joints to spin-welded flange adapters shall use gaskets (Viton) and bolts compatible with the connected piping service. No through-shell bolting is permitted.

G. Other considerations

1. Bolts shall be encapsulated in polyethylene or have gasketed flanged heads to prevent metal exposure to stored liquid and to resist rotation during installation. Encapsulation shall cover the entire head and at least 1/4 inch of adjacent threads.
2. Polyethylene encapsulation shall be color-coded to identify bolt material (white – 316 SS, green – titanium).

3. All flange and bolt assemblies shall be designed for continuous immersion in stored chemical and for hydrostatic head equal to full tank capacity.
4. Flange materials shall be CPVC or polypropylene, unless otherwise indicated on the Drawings.

2.6 Flexible Connections

A. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions that allows 4% tank design movement in the outward and downward directions, as per the Manufacturer's recommendation.

2.7 Accessories

A. Vents

1. Spin welded fitting for Tank Vent shall support a gooseneck vent.
2. Provide gooseneck vent, complying with OSHA requirements for normal atmospheric venting. Size shall be larger than the filling and withdrawal connections, and no less than 2 inch nominal inside diameter.
3. Construct gooseneck vents of Schedule 80 CPVC, installed with poly mesh insect screen. Design must incorporate secondary surge protection for filling with tanker truck, in the form of a 14-18" surge protection hinged lid that is self-closing when pressure has been released.

B. Site Level Gauge

1. Construct sight level gauge of flexible polyethylene tubing to allow for tank contraction and expansion due to loading and temperature changes. Connect the level gauge to the tank with two fittings, size per manufacturer. Provide each fitting with a right-angle isolation valve.
2. Construct the sight level gauge fittings and valves of CPVC. Gaskets shall be Viton.

C. Ultrasonic Level Indicator

1. The ultrasonic enclosure is to be an all-plastic design with a NEMA 4X rating. The ultrasonic transducer is to have a 12" dead band and beam with a 20 ft range. The supply voltage can be 110, 220 VAC or 24 VDC. The connection to the tank is to be 2" NPT.

2. Provide a spin welded fitting adapter on tank flat spot to encompass insert to hold an ultrasonic level sensor such that sensor is protected from the liquid with shop design drawing to be submitted by Contractor for approval.
3. The ultrasonic level indicator shall provide a visual display of liquid level in the tank showing gallonage in measurement of hundreds of gallons along with 4-20 mA output for other alarm or control systems as well as four independent contacts capable of handling 10 amps each. Each contact can be programmed to operate in different opening and closing methods (7 modes). Contacts can be used to control pumps, valves, alarms, etc.

D. Manways

1. Manway to be provided on top of tank, either threaded or bolted sealed in minimum 16" inner diameter. To be constructed of polyethylene material with appropriate bolting and gasket materials. Manway lid gasket is external to shell penetration and allowed under 2.4.F.

E. External Fill / Down Pipes

1. External fill pipes shall be as shown on the Drawings, supported at 5-ft maximum intervals with a support structure independent of the tank. Piping to be constructed of CPVC.
2. 2" Fill Line Connection with shop design drawing to be submitted by Contractor for approval, which allows for tank vertical expansion and contraction without damaging piping.
3.

F. Access Ladder

1. Provide a factory-fabricated ladder for permanent attachment to the tank wall, suitable for exposure in a chemical storage environment.
2. Ladder shall comply with OSHA 1910.23 requirements for fixed ladders.
3. Materials
    a. Rails and rungs: Fiberglass-reinforced plastic (FRP), UV-resistant, flame-retardant, and chemical-resistant.
    b. Color: Safety yellow, integrally pigmented.

4. Dimensions shall be as recommended by manufacturer for required span and loading.
5. Accessories
    a. Safety cage or fall-protection device if ladder height exceeds 20 feet, per OSHA requirements.
    b. Top step-off platform and handholds extending 42 inches above tank top.
    c. Wall brackets and standoffs of FRP or 316 stainless steel, minimum 7 inches clear from tank shell.
6. Finish and Performance
    a. Surfaces shall be smooth, free from sharp edges or splinters.
    b. FRP material shall be resistant to sodium hypochlorite environment and outdoor UV exposure.

G. Labeling

1. Furnish and install precautionary labeling on the tank in accordance with OSHA Hazard Communication Standard (29 CFR 1910.1200) requirements.
2. Labels shall identify the chemical stored, associated hazards, and safety precautions.
3. Provide additional labeling as recommended by the tank manufacturer and chemical supplier.

2.8 Anchors and Tie-Down Lugs

A. Design anchors and anchor bolts per IBC and structural requirements.

B. Tie-down lugs and anchor bolts shall be 316 stainless steel.

C. Lugs shall be integrally molded into the tank walls or bases or reinforced with FRP winding around the tank shell.

D. The tank shall have a minimum of 4 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of empty tanks. Tank shall be capable of being lifted into position as one whole unit.

2.9 Spare Parts

A. Manufacturer shall provide the spare parts that are recommended for the first two years of operation.

PART 3 -– EXCECUTION

3.1 Installation

A. The pump system shall be installed in accordance with the manufacturer's instructions. All installation personnel shall be trained and qualified in the areas of plumbing, electrical work, and instrumentation as required to complete the installation.

3.2 Factory Testing

A. Factory leakage testing shall be performed by filling the tank with water and holding it for minimum 12 hours. Tank, nozzles, knuckles, and all fittings shall be checked for leaks. Repair any leaks and retest until no leaks are observed.

B. Provide factory test report for the following:

1. Verification of wall thickness
2. Impact test
3. Gel test (Type I resin only)
4. Hydrostatic test
5. Verification of fitting placement
6. Visual inspection
7. Verification of materials

C. Clean tank at factory prior to shipment. Remove dirt, chips and debris from interior surfaces. Rinse with clean water; rinse and dry exterior with clean water.

3.3 Fusion Procedure and Quality Control

A. All penetrations shall be factory-installed. If field installation is required, Contractor shall coordinate with and follow Manufacturer approved fusion methods only.

3.4 Initial Start-up and Training

A. All equipment, components, piping and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of the Contractor to the above items shall be repaired or replaced by the Contractor to its original condition.

B. Hydrostatically test each tank in the field by filling with water and allowing tank to set for 24 hours. Check for leaks and correct or repair. Do not attached connecting piping until after the test period to allow for differential settlement.

C. During leak test, check that liquid level gauges operate smoothly, and any floats move up and down without sticking.

D. Interconnecting piping supplied by the Contractor to be hydrostatically tested by the Contractor.

E. National Fire Protection Association (NFPA) labels specifically coded for the tank contents shall be supplied and installed by the Contractor per NFPA 30.

F. The Contractor shall certify in writing that the tank system has been installed according to the tank manufacturer's instructions.

3.5 Warranty

A. The manufacturer shall warrant that their tank shall be free from manufacturing defects in materials and workmanship and that it will modify, replace or repair, within thirty-six (36) months from delivery. Fittings and accessories supplied by tank manufacturer to be warrantied for twelve (12) months from start-up or eighteen (18) months from delivery.

END OF SECTION

SECTION 014400

QUALITY CONTROL AND QUALITY ASSURANCE

PART 1 -GENERAL

1.1 DESCRIPTION

A. This Section describes responsibilities for the various aspects of Quality Control and Quality Assurance on this project. More specific requirements, details of tests and inspections, and modifications to the provisions of this Section appear in the detailed technical sections. Except as modified by the detailed technical sections or the Drawings, the provisions of this Section apply.

B. The types of Quality Control and Quality Assurance actions covered by this Section include (as applicable to current project):

1. Building Code inspections and tests
2. Special inspections
3. Construction materials testing
4. Construction observation
5. Painting and Coating thickness and holiday testing and inspection
6. Factory tests and certifications
7. Equipment checkout and acceptance testing
8. Pipeline testing
9. Hydraulic structure leakage testing
10. Electrical continuity and resistance testing
11. Pre-final and final inspections
12. Delegated design services

C. Related Sections:

1. Submittals in Section 013300.
2. Pipe Installation in Section 02535.
3. General Piping Requirements in Section 400500.

1.2 SUBMITTALS

A. Qualifications:

1. Except as prescribed below, where inspections and tests are to be provided by the Contractor or its sub-contractors or suppliers (at any level), the qualifications of the firm and/or individual are to be submitted to the Engineer for approval prior to conducting the tests.

2. Pre-approval is not required if the firm conducting the test is a qualified Independent Testing Agency or if the individual conducting or certifying the result is a Professional Engineer, licensed to practice in the State of Arizona, whose seal and signature appear on the report. In these cases, the qualifications need be submitted for approval of the Engineer only if requested.

B. Notification:

1. Where inspections and tests are to be provided by the Contractor or its sub-contractors or suppliers (at any level), the testing may be witnessed by the Engineer, or other representative of the Owner. Contractor must notify the Engineer, in writing, at least seven calendar days in advance of the testing. The written notifications must specify the exact time and date, and location, the equipment covered, the tests that will be conducted, and will define the test procedures to be utilized. Testing procedure and schedule shall be performed during normal working hours and will be subject to review by the Engineer.

2. Where inspections and tests are to be conducted by the Engineer, or other representative of the Owner, Contractor must notify the Engineer, in writing, at least seven calendar days in advance of the first inspection or test of each type, and at least 48 hours in advance of each subsequent test or inspection of that type.

C. Reports:

1. Reports of all inspections and tests required by the Contract Documents will be submitted to the Engineer for approval, within one week of the conduct of the test.

2. Where these reports are required by the Contract Documents to be "Certified", the report shall be signed with an appropriate certification and sealed by either a Professional Engineer or an officer of the corporation conducting the inspection or test.

3. Where inspections or tests are to be conducted or paid for by the Engineer or its sub-consultants, a copy of the report will be submitted to the Contractor within one week of the conduct of the inspection or test.

1.3 QUALITY ASSURANCE

A. Qualifications: All agencies and individuals conducting inspections and tests must be trained and experienced, to the satisfaction of the Engineer. Where certifications or qualifications are generally accepted as required for certain tests or inspections, the firm and/or individual shall possess such certifications or qualifications.

B. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. American Society for Testing and Materials (ASTM)
2. Hydraulic Institute (HI).
3. National Electrical Code (NEC).
4. National Electrical Manufacturers Association (NEMA).
5. Institute of Electrical and Electronic Engineers (IEEE).
6. American National Standards Institute (ANSI).
7. American Water Works Association (AWWA).

C. General: The Contractor is fully responsible for the quality of its Work, and for meeting all requirements of the Contract Documents. The conduct or lack of observations, inspections, and tests, whether by the Contractor, the Owner, or the Engineer, shall in no way relieve the Contractor of any of these responsibilities.

1.4 BUILDING CODE INSPECTIONS

A. The following types of Work shall be subject to Building Code Inspections and tests and will be performed or witnessed by the agency having jurisdiction over the project location (Agency). Specific requirements are given in the Governing Codes and permits.

1. Site work
2. Architectural
3. Structural
4. Fire Protection
5. Plumbing and Mechanical
6. Electrical

B. The Contractor must obtain all permits required by the Agency.

C. The Contractor must coordinate directly with the Agency for the scheduling and conduct of inspections and tests.

D. For the inspections conducted by the Agency, the Contractor must provide appropriate and safe access and will refrain from proceeding further until the inspection is passed.

E. When the Contractor conducts any tests or inspections, the Agency will witness them, if required. The Contractor will refrain from proceeding further until the test is passed.

F. The Contractor must fulfill all requirements of the Agency, including those not specifically addressed in the Contract Documents, and including requirements for rework, retest, and re-inspection. The Contractor must notify the Owner of any Agency requirement that the Contractor believes requires a change to the Contract Documents.

1.5 SPECIAL INSPECTIONS

A. Owner will provide all special inspection services unless noted otherwise.

B. Contractor must notify the Engineer a minimum of 48 hours prior to the required inspections.

C. The following types of Work will be subject to Special Inspections, which may be performed by the Engineer or the Resident Project Representative, or by such other special inspector as the Owner may employ:

1. Fill and Backfill.
2. Those types of work identified in the General Structural Notes and Statement of Special Inspections (Concrete, Masonry, Anchors, Bolting, Field Welding, etc.).
3. Post-installed anchors greater than 3/8” in diameter are subject to continuous inspection after drilling. Drilling for such anchors must be perpendicular to masonry or concrete surface within ±5°.
4. Rebar placement.
5. Grout and concrete pours.
6. Underground Electrical Work.
7. Lightning protection, Grounding and Cathodic Protection.

D. The special inspector shall be a qualified person who shall demonstrate competence to the satisfaction of the regulatory authorities for inspection of the particular type of construction or operation requiring special inspection.

E. The special inspector must furnish inspection reports to the regulatory authorities, the Engineer, the Contractor, and other designated persons. All discrepancies must be brought to the immediate attention of Contractor for correction, then, if uncorrected, to the Engineer and regulatory authorities.

F. Some inspections may be made on a periodic basis and satisfy the requirements of continuous inspection, provided this periodic scheduled inspection is performed as outlined in the Contract Documents and approved by the regulatory authorities.

1.6 CONSTRUCTION MATERIALS TESTING

A. Owner will provide all construction materials testing unless noted otherwise.

B. Contractor must notify Engineer a minimum of 48 hours prior to required construction and materials testing.

C. The following types of Work will be subject to Construction Materials Testing, which may be performed by the Resident Project Representative, or by an independent testing agency (Laboratory).

1. Soils and aggregate laboratory tests (gradation, plasticity, compaction, and moisture).
2. Soils field compaction and moisture content.
3. Concrete and masonry materials laboratory testing.
4. Fresh concrete and grout testing (slump, air content, etc.).
5. Asphalt concrete materials testing.
6. Asphalt concrete sampling, field density, and laboratory testing.
7. Structural metals inspections and testing (welding, bolting, etc.).
8. Anchor pull-testing.

D. The Owner will pay for the testing listed above, except for repeat testing that results from the Contractor's negligence or failure to meet Contract Document requirements.

E. Contractor is to pay for:

1. Tests not listed above.
2. Tests made for Contractor's convenience.
3. Repeat tests required because of Contractor's negligence or failure to meet Contract Document requirements.

4. Services of Testing Laboratory associated with delays or failures to meet notice requirements.

F. Qualifications of Laboratory

1. Where applicable, the laboratory will meet "Recommended Requirements for Independent Laboratory Qualification", latest edition, published by American Council of Independent Laboratories and the basic requirements of ASTM E329 "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction".
2. Devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants will calibrate testing equipment used by the laboratory at maximum twelve (12) month intervals.

G. The Laboratory shall:

1. Cooperate with Contractor and provide qualified personnel promptly on notice.
2. Perform specified inspections, sampling and testing of materials and methods of construction; comply with applicable standards; and ascertain compliance with requirements of Contract Documents.
3. Promptly notify Engineer and Contractor of irregularities or deficiencies of Work that are observed during the performance of services.
4. Promptly submit electronic copies of reports of inspections and tests to the Engineer, including:
    a. Date issued.
    b. Project title and number.
    c. Testing laboratory name and address.
    d. Date of inspection or sampling.
    e. Record of temperature and weather.
    f. Date of test.
    g. Identification of product and Specification Section.
    h. Location in Project.
    i. Type of inspection or test.

j. Results of tests and observations regarding compliance with Contract Documents.

5. Perform additional tests and services, as required by the Owner.

H. The testing laboratory is not authorized to approve or accept any portion of the Work; rescind, alter or augment the requirements of the Contract Documents; or perform any duties of Contractor.

I. Contractor must:

1. Cooperate with laboratory personnel and provide access to Work and to the manufacturer's operations.
2. Provide preliminary representative samples of materials to be tested, in required quantities to the laboratory.
3. Furnish copies of product test reports.
4. Provide to the laboratory, the preliminary design mix proposed for concrete and other material mixes that require testing by the testing laboratory.
5. Furnish labor and facilities: to provide access to Work to be tested, to obtain and handle samples at the site, to facilitate inspections and tests, and for storage and curing of test samples.
6. Notify the laboratory and the Engineer sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests. A minimum of 72 hours is required for initial tests/ inspections and 48 hours for ongoing tests or inspections.

1.7 CONSTRUCTION OBSERVATION

A. All Work will be subject to Construction Observation, which may be performed by the Engineer or other representative of the Owner. Observations may include visual observations and/or measurements and tests.

B. The Observer will conduct observations with as little disruption to the Contractor’s work as practical, and will report, orally, any discrepancies observed to the Contractor’s on-site foreman or superintendent.

C. The Contractor must suspend work, if required, and provide safe and appropriate access to the Observer. The Contractor must immediately correct any work observed to be out of compliance with the Contract Documents and suspend further related work until it is approved. If the Contractor believes that the Work is in compliance with the Contract Documents, he must immediately notify the Engineer and request direction.

1.8 PAINTING AND COATING THICKNESS AND HOLIDAY TESTING AND INSPECTION

A. Painting and Coating Work will be subject to Construction Observation, inspection, and testing of surface preparation, conformance to application requirements, coating thickness, and coverage.

B. Observations, surface preparation inspection, and wet-film thickness measurement will be conducted as specified for "Construction Observation."

C. Dry-film thickness and holiday testing will be conducted by the Contractor and witnessed by the Engineer, or other representative of the Owner.

D. The Contractor must immediately correct any work observed to be out of compliance with the Contract Documents and suspend further related work until it is approved. If the Contractor believes that the Work is in compliance with the Contract Documents, he must immediately notify the Engineer and request direction.

1.9 FACTORY TEST

A. Equipment will be subject to factory tests as prescribed in the individual technical sections.

B. Factory Tests will be conducted and paid for by the Contractor and may be witnessed by a representative of the Owner.

C. Unless otherwise specified in the technical section, the costs of the conduct and reporting of tests will be borne by the Contractor and travel and salary costs associated with witnessing factory tests shall be borne by the Owner.

D. The results of all required factory tests shall be certified and reported to the Engineer, for approval, prior to shipping the tested equipment.

E. If requested by the Contractor and approved by the Engineer, the requirement for factory tests for minor equipment may be met by certified tests of previously manufactured equipment of the same make, model, and capacity. Such request, along with the certified test results, must be submitted with the original equipment submittal. If Engineer requires individual test of the equipment for this project, the Contractor must ensure that such is done, at no additional cost to the Owner.

1.10 EQUIPMENT CHECKOUT AND ACCEPTANCE TESTING

A. The Contractor must provide equipment checkout and acceptance tests for:

1. All systems and motorized equipment specified in relevant Divisions.
2. All motorized valves, check valves, altitude valves, air release valves.
3. All control instruments, panels and systems.

B. The checkout and tests shall be conducted by qualified representatives of the manufacturers and may be witnessed by a representative of the Owner. Additional requirements for furnishing services of manufacturers' representatives are specified in the appropriate Sections.

C. Unless otherwise specified in the technical section, the costs of the conduct and reporting of tests will be borne by the Contractor. Such costs include all labor, travel, chemicals, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided.

D. Preliminary Tests: Prior to, or in conjunction with activities prescribed by Section 017516 and each Equipment Section, Contractor shall perform preliminary tests as follows:

1. Contractor is to make preliminary field tests of all equipment as soon as conditions permit.
2. Purpose of tests is to determine if the equipment is properly installed, in compliance with operating cycles, operational and free from overheating, overloading, vibration or other operating problems.
3. Contractor must make all changes, adjustments and replacements required to place the equipment in service and test it.
4. Engineer and Owner must be given sufficient notice prior to tests. A minimum 48-hour notice must be given.

E. Final Tests (After Preliminary Tests):

1. To the maximum extent possible, Contractor must perform final field tests of equipment and systems prior to initial start-up and operation of the Project. Where this is not practicable, Contractor will request, in writing, approval of the Engineer, to perform final testing simultaneously with start-up. Contractor must define procedures necessary to comply with the requirements of each Equipment Section.
2. Purpose of the tests is to demonstrate that equipment is properly installed, completely ready for operation by the Owner, and in

compliance with design conditions, material specifications and all other requirements of the Contract Documents.

3. Until final field tests are completed and approved, Contractor must make all necessary changes, adjustments and replacements.

4. Systems or unit process or any piece of equipment must not be started-up without the approved Operation and Maintenance Manuals being turned over to the Owner.

5. Contractor must keep notes and data on tests and submit a copy to the Engineer. Engineer and Owner's operating personnel will witness all tests.

F. Within fourteen (14) calendar days after installation, and before payment for installation is approved, Contractor must submit a letter from the manufacturer to the Engineer, on the manufacturer's letterhead, stating all the equipment and components are installed in accordance with the manufacturer's requirements and installation instructions as described in these Specifications.

1.11 PIPELINE TESTING

A. The Contractor must test all new and modified piping and follow requirements in Section 02535, Pipe Installation.

1.12 HYDRAULIC STRUCTURE LEAKAGE TESTING

A. The Contractor is to test all water-bearing concrete structures for leakage.

B. The Contractor must provide water, piping, and equipment to test concrete structures for leakage.

C. The ACI 350.1-10 standard hydrostatic test (HST) criteria for hydraulic structures are expressed as the maximum allowable percent loss per day of the test water volume. The designation for these structures is HST-100 or 0.100% per day of volume loss for all the structures.

1.13 ELECTRICAL CONTINUITY AND RESISTANCE TESTING

A. The Contractor must provide all electrical continuity and resistance testing required by the technical Sections and the governing Codes.

1.14 PRE-FINAL AND FINAL INSPECTIONS

A. When the Contractor believes that the Work is substantially complete, as defined by the General Conditions and Supplemental Conditions of the Contract, Contractor will notify the Engineer, in writing, in accordance

with these Conditions. The Contractor, the Engineer, and the Owner, in accordance with the General Conditions and Supplemental Conditions of the Contract, will conduct pre-Final and Final Inspections.

1.15 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect / Engineer.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, licensed in the State of Arizona, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated as well as all governing codes and regulations. Include list of codes, loads, and other factors used in performing these services.

PART 2 - MATERIALS (NOT USED)

PART 3 - EXECUTION

3.1 PIPELINE TESTING

A. Follow procedures in Specification Section 02535 (Pipe Installation), AWWA C600 and C605, and MAG Specification Section 611.

3.2 SOILS AND MATERIALS TESTING

A. This covers the Submittals and Quality Assurance/Quality Control for Soils and Materials including sand, bedding, fill, backfill and aggregate for Trenches, Structures, Subgrade Preparation, and Aggregate Base Course.

B. Submittals: Submit as specified in Section 013300.

C. Quality Assurance/ Quality Control

1. Reference Test Standards and Specifications

    a. Lake Havasu City Engineering Specifications.

b. ASTM C94 - Ready Mix Concrete.

c. ASTM C117 - Test Method for Material Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.

d. ASTM C131 - Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

e. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

f. ASTM D698 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.

g. ASTM D1556 - Density of Soil in Place by the Sand Cone Method.

h. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

i. ASTM D2922 - Density of Soil and Soil Aggregate in Place by Nuclear Methods.

j. ASTM D3017 - Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods.

k. ASTM D4215, Standard Specification for Cold Mixed, Cold Laid Bituminous Paving Mixture.

l. ASTM D4253 - Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

m. ASTM D4254 - Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

n. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

o. ASTM D6938-08a, Density of Soil and Soil-Aggregate in Place by Nuclear Methods.

p. Rock Correction Procedure for Maximum Density Determination, AASHTO T99 and ARIZ 227.

q. Occupational Safety and Health Administration (OSHA), Part 1926 - Safety and Health Regulations for Construction.Earthwork

r. Arizona Department of Environmental Quality, Engineering Bulletin No. 11, minimum requirements for design and submission of plans and specifications of sewage works

D. Frequency of Testing

1. Test frequencies will be established at the discretion of the Engineer and Owner, or as noted in the specific sections below.
2. The Engineer, at the discretion of the Owner, may perform quality assurance testing for compaction, gradation, and plasticity index, as appropriate for the material.
3. In the event of a failure of a quality assurance test, the non-complying materials will be removed and replaced or reworked by the Contractor. Quality Control tests shall be performed to verify an acceptable condition prior to quality assurance re-tests by the Engineer.

E. Quality Control Testing

1. The Contractor is required to provide a reasonable level of quality control testing to ensure that materials incorporated into the work and soils compaction methods achieve a product that complies with the specification.
2. The Contractor must provide the results of all quality control construction testing to the Engineer as soon as they are available.
3. The Contractor shall retain the services of a qualified laboratory to provide quality control testing.
4. The Contractor shall provide all geotechnical inspections and testing performed by an Arizona Registered Engineer. The Engineer reviewing the geotechnical inspections and testing shall provide a written certification with engineer's seal and supporting documentation to the project Engineer certifying that soils and materials including trench backfill have been installed and compacted per plans and specifications.
5. The following items describe the minimum number of quality control tests, tolerances and reports required by the Contractor.
    a. Maximum Dry Density and Optimum Moisture Content, ASTM D1557.
        i. One test for each different class or type of material shall be performed prior to beginning construction, performing any earthwork operations, or placing aggregate base, as is appropriate.
        ii. Additional tests shall be performed when previous tests are suspect, or if changes in the material are

detected either by the Contractor or as determined by the Owner/Engineer.

iii. Contractor shall provide 5 days' notice to Engineer prior to beginning Aggregate Base placement to allow adequate time for quality assurance sampling and testing.

b. Density of Soil In Place by the Sand Cone or by Nuclear Methods, ASTM D1556 or D2922.

i. Earthwork:

1. Perform a minimum of one test per lift per 5,000 square yards per each type of material.

ii. Trench Excavation and Backfill:

1. Perform a minimum of one test per foot of depth of trench for Select Backfill and Bedding Sand, ranging from one test every 250' up to 500', with a minimum 1 test per lift per pipe run, stub out or lateral.

2. The tests shall be evenly distributed throughout the depth of materials in the trench. If insufficient test results are presented representing a given depth (i.e. inadequate number of tests at lower depths in the trench) the Contractor shall pothole the completed backfill to acquire additional test results such that the specified frequencies and depth distributions are achieved.

iii. Excavation, Filling and Backfilling for Structures:

1. Perform a minimum of one test per 3 feet of depth per manhole or other structure requiring backfill or select backfill.

2. The tests shall be evenly distributed throughout the depth of materials in the excavation. If insufficient test results are presented representing a given depth (i.e. inadequate number of tests at lower depths in the excavation) the Contractor shall pothole the completed backfill to acquire additional test results such that specified

frequencies and depth distributions are achieved.

iv. Subgrade Preparation:

1. Perform a minimum of one test per 2,000 square yards per type of material.

v. Aggregate Base Course:

1. Perform a minimum of one test per lift per 2,000 square yards per source of material.

vi. All: Perform additional tests as required to verify proper compaction has been achieved.

c. Method for Sieve Analysis of Fine and Coarse Aggregates, ASTM C136.

i. Trench Excavation and Backfill:

1. One test per 1,000 cy of Bedding Sand Material incorporated into the work.

2. One test per 5,000 cy of Select Backfill Material incorporated into the work.

ii. Excavation, Filling and Backfilling for Structures:

1. One test per 5,000 cy of Select Backfill Material incorporated into the work.

iii. Aggregate Base:

1. Perform sampling of Aggregate Base in windrows on the grade or from delivery units at a frequency of one sample per 2,000 tons of material delivered. Test each sample for conformance with gradation and plasticity index requirements

d. Plasticity Index of Soils, ASTM D4318.

i. Trench Excavation and Backfill:

1. One test per 1,000 cy of Bedding Sand Material incorporated into the work.

2. One test per 5,000 cy of Select Backfill Material incorporated into the work.

ii. Excavation, Filling and Backfilling for Structures:

1. One test per 5,000 cy of Select Backfill Material incorporated into the work.

e. Testing Tolerances

i. Relative Percent Compaction

1. Not less than as specified on plans or in these specifications.

ii. In Place Moisture Content

1. +2% of optimum moisture, and as required to achieve maximum relative density.

iii. Soft or Yielding Surfaces

1. Regardless of the percent compaction obtained by the test, areas that are soft and yield under the load of construction equipment are to be removed and replaced at no additional cost.

F. Materials Test Reports

1. The Contractor shall submit source qualification test results showing compliance with the materials specifications, including maximum dry density and optimum moisture content of each soil material prior to beginning that aspect of work, or importing materials to the project.
2. Report on bedding and backfill materials compliance tests as required.
3. Compaction test reports shall be submitted to Engineer within two (2) business days of completion of a given test.

3.3 ASPHALT CONCRETE PAVEMENT

A. Submittals:

1. The Contractor shall provide all preliminary materials and mix design testing and the mix design report in accordance with Section 013300, Submittals.
2. Certificates of Compliances
   a. Mineral Filler
   b. Asphalt Cement
   c. ARPA plant certification

d. Plant scale and metering device calibration

B. Quality Assurance/ Quality Control

1. Compliance sampling and testing during construction will be provided by the Owner.
2. Reference Test Standards and Specifications
   a. ASTM C88, Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
   b. ASTM C117, Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
   c. ASTM C131, Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
   d. ASTM C136, Sieve or Screen Analysis of Fine and Coarse Aggregates
   e. ASTM C150, Portland Cement
   f. ASTM C183, Sampling Hydraulic Cement
   g. ASTM C977, Specification for Quicklime and Hydrated Lime for Soil Stabilization
   h. ASTM D75, Practice for Sampling Aggregates
   i. ASTM D140, Practice for Sampling Bituminous Materials
   j. ASTM D242, Mineral Filler for Bituminous Paving Mixtures
   k. ASTM D692, Coarse Aggregate for Bituminous Paving Mixture
   l. ASTM D946, Penetration-Graded Asphalt Cement for Use in Pavement Construction
   m. ASTM D995, Requirements of Mixing Plants for Hot-Mixed Hot-Laid Bituminous Paving Mixtures
   n. ASTM D1073, Fine Aggregate for Bituminous Paving Mixture
   o. ASTM D1075, Effect of Water on Cohesion of Compacted Bituminous Mixtures
   p. ASTM D1188, Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
   q. ASTM D1559, Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

r. ASTM D2041, Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

s. ASTM D2172, Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

t. ASTM D2419, and Equivalent Value of Soils and Fine Aggregate

u. ASTM D2489, Degree of Particle Coating of Bituminous-Aggregate Mixtures

v. ASTM D2726, Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

w. ASTM D2950, Density of Bituminous Concrete In-Place be Nuclear Methods

x. ASTM D3381, Viscosity-Graded Asphalt Cement for Use in Pavement Mixtures

y. ASTM D3515, Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

z. ASTM D3549, Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimen

aa. ASTM D3665, Random Sampling of Paving Materials

bb. ASTM D3666, Inspection and Testing Agencies for Bituminous paving Materials

cc. ASTM D4318, Liquid Limit, Plastic Limit, and Plasticity Index of Soils

dd. Lake Havasu City (LCHAZ) approved Concrete Mix Designs.

ee. The Asphalt Institute, Mix Design Methods for Asphalt Concrete Manual No. 2 (MS-2), 1992 or its latest revision.

ff. LHC, Uniform Standard Specifications for Public Works Construction, 2019 Edition (Includes revisions through 2021).

gg. Arizona Department of Transportation (ADOT), Standard Specifications, 2000 Edition 1.2 Quality Assurance.

C. Quality Control Testing

1. The Contractor is required to provide a reasonable level of quality control testing to ensure that materials incorporated into the work

and plant operations achieve a product that complies with the specifications without significant numbers of failures and asphalt concrete penalties.

2. Acceptance testing provided by the Owner is not sufficient for controlling the plant or paving operation. The Contractor is required to provide nuclear density testing during compaction to assess density while the compaction operation is ongoing.

D. Frequency of Testing

1. The following table indicates the minimum number of tests to be performed for acceptance of each lot.

Test Description	Test Method	Test Frequency
Maximum Density of Laboratory Compacted Mixture	ASTM D1559 ASTM D2726	3 tests per lot
Asphalt Cement Content of Uncompacted Mixture	ASTM D2726	3 tests per lot
Aggregate Gradation of Uncompacted Mixture	ASTM C136 ASTM C117	3 tests per lot
In-Place Density of Compacted Mixture	Core Samples ASTM D2726 or	3 to 5 randomly distributed core samples per lot
Thickness of Compacted Mixture	ASTM D3549	3 to 5 randomly distributed core samples per lot
Temperature of Mix at Time of Placement	Field Thermometer	1 test per 100 L.F. of paving lane width
Straight Edge	16-foot straightedge	Continuously

2. Locations for sampling and in-place tests shall be in accordance with ASTM D3665. The Contractor shall provide extra tests as required by the Owner to define deficient areas at no additional cost to the Owner.

3. Acceptance samples shall be taken from behind the paving machine with a sampling plate. The acceptance laboratory and quality control laboratory shall utilize the ignition method (ASTM D6307) with the appropriate calibration/corrections applied for both gradation and binder content testing.

4. Three (3) cores should be used for acceptance testing if the production of the lot is less than 1,000 tons. Four (4) cores should be used for lots containing 1,000 to 1,500 tons, and five (5) cores for lots exceeding 1,500 tons.

5. The density of the compacted mixture shall be determined from core samples cut from the pavement. The relative density of the finished product shall be determined by dividing the specific gravity of the core by the average Marshall specific gravity obtained for the corresponding lot.

6. Allowable Tolerances

   a. The following table provides the tolerance for individual test results that will be allowed without adjustment to payment.

Description	**Allowable Tolerance**
Relative Density	-1 percent
Asphalt Cement Content	$\pm$ 0.3 percent
Aggregate Gradation, Job Mix Tolerances	
Aggregate Passing No. 4 Sieve or Larger	$\pm$6 percent
Aggregate Passing Nos. 8 and 30 sieves	$\pm$6 percent
Aggregate Passing 200 sieves	$\pm$2 percent
Thickness of Compacted Mixture	-1/4-inch
Temperature of Mix at Time of Placement	+25 degrees Fahrenheit
Straightedge, Finish Course	+1/4-inch

7. Acceptance

   a. In-place materials with deviations in excess of the allowable tolerances will be either removed and replaced or paid for at a reduced unit price as dictated herein. The penalties shown in the tables following are not cumulative within the same table.

   b. Relative Density

      i. Deviations from specifications will be based on the average values of acceptance testing performed for

each lot and will be based on 95% of the Marshall Specific Gravity. When the relative density is greater or less than that specified, payment will be reduced as follows:

Deviation from Density Specifications	**Reduction in Payment**
0 to -1% points	0%
Greater than -1% point	- 2%
Greater than -2% points	- 5%
Greater than -3% points	- 10%
Greater than -5% points	Rejected

ii. When the relative density deviates from that specified by more than 5 percent, remove and replace that section of asphalt concrete pavement in accordance with specifications at no additional cost to the Owner.

c. Asphalt Cement Content

i. Deviations from specifications will be based on the average values of acceptance testing performed for each lot. When the asphalt cement content exceeds the allowable tolerance of +0.3 percent from the approved mix design target value, the payment will be reduced, or the material rejected as follows:

Deviation from Asphalt Cement Content Target Value	**Reduction in Payment**
0 to ±0.3% points	0%
Greater than ±0.3% points	-2%
Greater than ±0.4% points	-5%
Greater than ±0.5% points	Rejected

d. Aggregate Gradation

i. When the aggregate gradation exceeds the allowable job mix tolerances, that asphalt concrete pavement will be removed and replaced in

accordance with the specifications at no additional cost to the Owner.

e. Thickness

i. Deviations from specifications will be based on the average values of acceptance testing performed for each lot. Where the pavement is deficient in thickness by not more than -1/4-inch, payment will be reduced by 25 percent. Where the pavement is deficient in thickness by more than 1/4-inch, pavement shall be rejected. In the event that an individual core is deficient in thickness by more than 3/8-inch, two additional cores will be taken, one approximately 100 feet ahead of the deficient core and one approximately 100 feet behind the deficient core. These three cores will be used to evaluate the deficiency of that area and it will be treated as a new sub lot regarding thickness acceptance. If the new sub lot is deficient, additional cores may be needed to determine the extent of the deficiency. For pavement sections requiring multiple lifts, the acceptance for the thickness shall be based solely on the overall thickness measured on the cores from the top lift.

Deviation from Minimum Thickness Specifications	**Reduction in Payment**
Spec. to – 1/8-inch	0%
Spec. minus 1/8-inch to spec minus 1/4-inch	-25%
Less than Spec. minus 1/4-inch	Rejected

f. Effective % Air Voids

i. When the percent laboratory air voids (75 blow Marshall method) exceed the allowable mix design tolerances, the following table shall be used to determine pay reduction or determine if pavement needs to be removed and replaced. Deviations from specifications will be based on the average values of acceptance testing performed for each lot.

Deviation from Target Percent Air Voids	Reduction in Payment
0 to ± 2%	Full Payment
± 2.1% to ± 2.9%	-5%
Greater than ± 3%	Rejected

g. Straightedge

i. Where the finish surface deviates from a true plane as determined by using a 16-foot straightedge in excess of 1/4-inch, the surface shall be removed and replaced in accordance with these specifications with a method approved by the Owner and shall be provided at no additional cost to the Owner. The repair shall be accomplished by completely removing and replacing the section or grinding down and replacing with a minimum of 2-inch overlay. The 16-foot straightedge shall be furnished by the Contractor.

E. Materials Test Reports

1. Report on Coarse Aggregate
2. Report on Fine Aggregate
3. Asphalt Concrete Mix Design; include the following items in the report:
   a. Name and address of laboratory and responsible party
   b. Location of source of aggregate
   c. Supplier, refinery and grade of asphalt cement
   d. Supplier and source of admixture
   e. Individual aggregate gradations
   f. Combined aggregate gradations
   g. Job mix formula
   h. Aggregate and mix design test results and voids analysis
   i. Recommended asphalt cement content
   j. Recommended lay down temperature
   k. Recommended mixing temperature

l. Complete set of calculations

****END OF SECTION****

SECTION 017516

EQUIPMENT AND SYSTEM START-UP AND PERFORMANCE TESTING

PART 1 -GENERAL

1.1 DESCRIPTION

A. This Section contains requirements for documenting start-up and performance testing Work required under this Contract, including general requirements during start-up and performance testing of all mechanical, electrical, instrumentation, and HVAC equipment and systems installed by the Contractor. This Section supplements, but does not supersede, specific testing requirements found elsewhere in the Contract Documents.

B. Contractor must initially start-up and place all equipment installed by Contractor into successful operation according to manufacturer's written instructions and as instructed by manufacturer's field representative. Provide all materials, labor, tools, equipment, chemicals, lubricants, and expendables required to complete start-up.

C. No system or sub-system may be started up for continuous operation unless all components of that system or sub-system, including instrumentation, have been tested and proven to be operable as intended by the Contract Documents.

D. For the purposes of this Section, a system shall include all required items of equipment, devices and appurtenances connected in such a fashion as their operation or function complements, protects or controls the operation or function of the others.

E. A draft testing, start-up, and commissioning plan must be submitted to the Owner and Engineer for review and comment at 60 percent of project construction. A final plan must be submitted at 90 percent of project construction.

F. Training shall be coordinated with start-up to ensure that training can be performed with operational equipment.

G. Related Sections:

1. Project Coordination, Meetings, and Schedules in Section 013200.
2. Submittals in Section 013300.
3. General Equipment Provisions and Installation in Section 016100.
4. Demonstration and Training in Section 017900.
5. Product-specific Specifications in applicable Sections.

6. Field Testing in Section 16950.

1.2 REFERENCE STANDARDS

A. American National Standards Institute (ANSI).
B. American Society of Mechanical Engineers (ASME).
C. American Society for Testing and Materials (ASTM).

1.3 DEFINITIONS

A. Contractor Testing consists of, but is not limited to, the individual and system tests of all mechanical, electrical, HVAC, and instrumentation equipment and systems, and must demonstrate compliance with the performance requirements of the Contract Documents.
B. Demonstration Testing is required to show the Owner all equipment as a system will function as designed. The testing will simulate various operating conditions to allow the system as a whole to react.
C. Supplier Equipment Setup, Calibration and Checkout consists of, but is not limited to, Pressure or leakage tests; Electrical testing as specified in Division 26; individual component, loop, loop commissioning and tuning testing; and pre-start-up checkout for all mechanical and HVAC equipment.

1.4 SUBMITTALS

A. Submit the following for approval:

1. A complete description of Contractor's plan for documenting the results from the test program in conformance with the requirements of the Documentation section, below, including:
    a. Sample forms for documenting the results of field pressure and performance tests.
    b. List of all Tag numbers.
2. Pre-startup check out procedures, reviewed and approved by the respective equipment manufacturers.
3. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by Contractor for the systematic startup and performance testing of all equipment and systems installed under this Contract.
4. A schedule and subsequent updates, presenting Contractor's plan for startup and performance testing the equipment and systems installed under this Contract.
5. A schedule establishing the expected time period (calendar dates) when Contractor plans to commence performance testing of the completed systems, along with a description of the temporary

systems and installations planned to allow operational testing to take place.

6. Written notice to Engineer a minimum of 72 hours prior to beginning of any test.

7. All records produced during the startup and testing program, including:

   a. Final HVAC test and balance reports.

   b. Equipment testing and start-up reports.

B. Systems or unit process or any piece of equipment may not be started up without the approved Operation and Maintenance Manuals being turned over to the Owner.

1.5 QUALITY ASSURANCE

A. Contractor must have a Quality Assurance Program. This program must include:

1. Testing plan setting forth the sequence in which all testing Work required under the Contract Documents will be implemented.

2. Documentation program to record the results of all equipment and system tests.

3. Installed start-up and performance testing program for all mechanical, electrical, instrumentation, and HVAC equipment and systems installed under this Contract.

4. Calibration program for all instruments, gages, meters, and thermometers used for determining the performance of equipment and systems installed under this Contract.

5. Testing schedule conforming to the requirements specified in the Documentation section below.

B. Calibration:

1. All test equipment (gauges, meters, thermometers, analysis instruments, and other equipment) used for calibrating or verifying the performance of equipment installed under this Contract must be calibrated and certified per equipment or instrument standard requirements.

2. Pressure gauges are to be calibrated in accordance with ANSI/ASME B40.1.

3. Thermometers are to be calibrated in accordance with ASTM E77.

4. Flow meter calibration work must be performed by individuals skilled in the techniques to be employed.

1.6 ADJUSTMENTS

A. Until final tests are completed and approved, Contractor to make all necessary changes, adjustments, and replacements.

1.7 PLANS

A. Prepare test plans and documentation plans as specified in the following paragraphs. The Owner and Engineer will not witness any test work for the purpose of acceptance until all test documentation and calibration plans and the specified system or equipment test plans have been submitted and approved.

1.8 DOCUMENTATION

A. Documentation Plans

1. Equipment and system documentation must include date of test, equipment number of system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for the Owner's and Engineer's witnesses and the Contractor.
2. The documentation must include the following information at a minimum:
    a. Factory performance tests.
    b. Field calibration tests
    c. Field pressure tests
    d. Field performance tests
    e. Field operational tests

B. Test Plans

1. Develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this Contract. Each test plan must be specific to the item of equipment or system to be tested.
2. Test plans must identify by specific equipment each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans must also be specific as to support systems required to complete the test work, temporary systems required during the

test work, subcontractors and manufacturers' representatives to be present and expected test duration.

3. As a minimum, the test plans shall include the following features:
    a. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device.
    b. Calibration of all analysis instruments and control sensors.
    c. Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests must be selected to duplicate the operating conditions described in the Contract Documents.
    d. System performance tests designed to duplicate, as closely as possible, operating conditions described in the Contract Documents.
4. Test plans must contain a complete description of the procedures to be employed to achieve the desired test environment.
5. Testing must be designed to duplicate, as closely as possible, the operating design and to clearly show that the system works in various conditions and as detailed in the Process and Instrumentation drawings and Control Narratives, if available.
6. Testing for any individual system must be performed in the following order, unless Contract has specific written authorization of the Engineer:
    a. Supplier Equipment Setup, Calibration and Checkout
    b. Contractor Testing
    c. Demonstration Testing
7. Prior to scheduling start-up and testing the Contractor must:
    a. Have submitted all test plans required for the systematic field performance and operational tests for all equipment and systems installed under this Contract.

C. Testing Schedule

1. Provide a startup and testing schedule setting forth the sequence contemplated for performing the test work.
2. The schedule is to be a Critical Path Method (CPM) format, plotted against calendar time, must detail the equipment and systems to be tested, and be coordinated with Contractor's Progress Schedule

specified in Section 013200, Project Coordination, Meetings, and Schedules.

3. The schedule must show the contemplated start date, duration of the test and completion of each test. The test schedule must be submitted no later than four weeks in advance of the date testing is to begin.

4. The test schedule must be updated as needed, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of the Contract Documents.

PART 2 -MATERIALS (NOT USED)

PART 3 -EXECUTION

3.1 SYSTEM AND EQUIPMENT PERFORMANCE TESTS

A. Each item of mechanical, electrical, instrumentation and HVAC equipment installed under this Contract must be tested in accordance with and to demonstrate compliance with the performance requirements of the Contract Documents.

B. All equipment and systems are to be tested individually, in accordance with the requirements below, to demonstrate successful operation according to the manufacturer's instructions.

C. Once all equipment and systems have been tested individually, proceed with performance testing in accordance with the requirements below, simulating actual operating conditions to the greatest extent possible.

1. Install temporary connections, bulkheads and make other provisions to recirculate process fluids or otherwise simulate anticipated operating conditions.

2. During the operational testing period, Contractor will monitor the characteristics of each equipment and system and report any unusual conditions to the Engineer.

3.2 INDIVIDUAL EQUIPMENT AND SYSTEM START-UP

A. General Requirements

1. Perform installation, Supplier Equipment Setup, Calibration, and Checkout prior to start-up. Pre-startup checkout procedures must be reviewed and accepted by the respective equipment manufacturer.

2. Perform Equipment Checkout. Prior to energization (in the case of electrical systems and equipment), all circuits must be rung out and tested for continuity and shielding in accordance with the requirements of Division 26.

3. Perform Component Calibration and Loop Testing. Prior to energization (in the case of instrumentation system and equipment), all loops and associated instruments shall be calibrated and tested, as specified in respective equipment specifications.

4. Perform Electrical Resistance testing in accordance with the requirements of Division 26.

5. Perform Pressure and Leakage Tests in accordance with applicable sections. All acceptance tests must be witnessed by the Engineer. Evidence of successful completion of the pressure and leakage tests must include the Engineer's signature on the test forms prepared by Contractor.

6. Perform Pre-startup tests, including the following:

    a. Alignment of equipment.

    b. Pre-operation lubrication.

    c. Tests in accordance with manufacturer recommendations for pre-start preparation and pre-operational check out procedures.

7. Pre-startup tests must conform to the requirements of Section 016100, General Equipment Provisions and Installation.

8. General Start-up Activities Include:

    a. Cleaning.

    b. Removing temporary protective coatings.

    c. Flushing and replacing greases and lubricants, where required by manufacturer.

    d. Lubrication.

    e. Check shaft and coupling alignments and reset where needed.

    f. Check and set motor, pump and other equipment rotation, safety interlocks, and belt tensions.

    g. Check and correct if necessary leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping which may put stress on pumping equipment connected to it.

h. All adjustments required.

9. Provide chemicals and lubricants and all other required operating fluids.

10. Provide fuel, electricity, water, filters, and other expendables required for start-up of equipment, unless otherwise specified.

11. Owner must provide sufficient personnel to assist Contractor in the start-up, but the prime responsibility for proper mechanical operation belongs to Contractor. Manufacturer's representatives must be present during initial start-up and operation, unless otherwise acceptable to Engineer.

12. No system, unit process, or any piece of equipment may be started up for continuous operation without the approved Operation and Maintenance Manuals being turned over to the Owner.

13. Training must be provided prior to turning the operation of a system, unit process or piece of equipment over to the Owner. Training must be scheduled for each plant staff work shift accordingly. See Demonstration and Training requirements in Section 017900.

14. Completion of start-up will occur when the Owner assumes responsibility for operation of the equipment. If the Owner does not assume operational responsibility and in the opinion of the Engineer start-up tasks are completed, the Engineer will notify Contractor, in writing, of the completion of the start-up period.

B. Minimum Start-up Requirements

1. Bearings and Shafting:

   a. Inspect for cleanliness, and clean and remove all foreign materials.

   b. Verify alignment.

   c. Replace defective bearings and those that run rough or noisy.

   d. Grease as necessary and in accordance with manufacturer's recommendations.

2. Drives:

   a. Adjust tension in V-belt drives and adjust varipitch sheaves and drives for proper equipment speed.

   b. Adjust drives for alignment of sheaves and V-belts.

c. Clean and remove foreign materials before starting operation.

3. Motors:

   a. Check each motor for comparison to amperage nameplate value.

   b. Correct conditions that produce excessive current flow and exist due to equipment malfunction.

4. Pumps:

   a. Check glands and seals for cleanliness and adjustment before running pump.

   b. Inspect shaft sleeves for scoring.

   c. Inspect mechanical faces, chambers, and seal rings, and replace if defective.

   d. Verify that piping system is free of dirt and scale before circulating liquid through the pump.

5. Valves:

   a. Inspect both hand and automatic control valves, and clean bonnets and stems.

   b. Tighten packing glands to assure no leakage but permit valve stems to operate without galling.

   c. Replace packing in valves to retain maximum adjustment after system is determined to be complete.

   d. Replace packing on any valve that continues to leak.

   e. Remove and repair bonnets that leak.

   f. Coat packing gland threads and valve stems with a surface preparation of "Moly-Cote", "Fel-Pro", or equal after cleaning.

6. Verify that control valve seats are free from foreign material and are properly positioned for intended service.

7. Tighten flanges and all other pipe joints after system has been placed in operation.

   a. Replace gaskets that show any sign of leakage after tightening.

8. Inspect all joints for leakage.

   a. Promptly remake each joint that appears to be faulty; do not wait for rust to form.

b. Clean threads on both parts and apply compound and remake joints.

9. After system has been placed in operation, clean strainers, drives, pockets, orifices, valve seats and headers in fluid system to assure freedom from foreign materials.

10. Open steam traps and air vents, where used, and remove operating elements.

    a. Clean thoroughly, replace internal parts and put back into operation.

11. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.

12. Set and calibrate draft gauges of air filters and other equipment.

13. Inspect fan wheels for clearance and balance.

    a. Provide factory-authorized personnel for adjustment when needed.

14. Check each electrical control circuit to assure that operation complies with Specifications and requirements and to provide desired performance.

15. Test and calibrate all instrumentation and measuring devices.

16. Inspect each pressure gauge and thermometer for calibration.

    a. Replace items which are defaced, broken, or which read incorrectly.

17. Repair damaged insulation.

18. Vent gases trapped in any part of systems.

    a. Verify that liquids are drained from all parts of gas or air systems.

3.3 QUALITY ASSURANCE PROGRAM

A. Organize teams made up of qualified representatives of equipment suppliers, subcontractors, Contractor's independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this Contract.

B. The objective of the testing program is to demonstrate, to the Owner's and Engineer's complete satisfaction, that the structures, systems, and equipment constructed and installed under this Contract meets all performance requirements and the facility is Substantially Complete and

ready for the commissioning process to commence. In addition, the testing program must produce baseline-operating conditions for the Owner to use in a Preventive Maintenance Program.

3.4 CALIBRATION OF FIXED INSTRUMENTS

A. Calibration of analysis instruments, sensors, gauges, and meters installed under this Contract must proceed on a system-by-system basis. No equipment or system performance test may be performed until all instruments, gauges, and meters to be installed in that particular system have been calibrated.

3.5 SYSTEM PERFORMANCE TESTS

A. Once all affected equipment has been subjected to the required pre-operational checkout procedures and the Engineer has witnessed and has not found deficiencies in that portion of the Work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine, as nearly as possible, whether the equipment and systems meet the requirements of these specifications.

B. For each system performance test phase, the equipment must be operated a sufficient period of time to determine machine operating characteristics, including noise, temperatures and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls, and shall last no less than 8 continuous hours.

C. When testing requires the availability of auxiliary systems, such as looped piping, electrical power, compressed air, control air, or instrumentation that have not yet been placed in service, provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system, at no additional cost to the Owner.

D. Disposal methods for test media are subject to review and approval by the Owner and Engineer.

E. During the performance test period, obtain baseline-operating data on all equipment with motors greater than one (1) horsepower (hp) to include amperage, bearing temperatures, and vibration. The baseline data must be collected for the Owner to enter in a Preventive Maintenance Program.

F. Test results must be within the tolerances set forth in the detailed specification sections of the Contract Documents. If no tolerances have been specified, test results must conform to tolerances established by recognized industry practice.

1. Where, in the case of an otherwise satisfactory performance test, any doubt, dispute, or difference should arise between the Engineer and Contractor regarding the test results or the methods or equipment used in the performance of such test, then the Engineer may order the test to be repeated. If the repeat test, using such modified methods or equipment as the Engineer may require, confirms the previous test, then all costs in connection with the repeat test will be paid by the Owner. Otherwise, the costs must be borne by Contractor.

2. Where the results of any performance test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements must be made by Contractor at his expense.

G. Provide, at no expense to the Owner, all power, fuel, compressed air supplies, water, and chemicals, all labor, temporary piping, heating, ventilating, and air conditioning for any areas where permanent facilities are not complete and operable at the time of functional tests, and all other items and work required to complete the functional tests. Temporary facilities must be maintained until permanent systems are in service.

H. Should the testing period be halted for any reason, the operational testing program must be repeated, until the specified continuous period has been accomplished without interruption. All process units must be brought to full operating conditions, including temperature, pressure, flow and level.

I. Phase Retesting: If under test, any portion of the Work should fail to fulfill the Contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the Work as are affected thereby, must, unless otherwise directed by the Engineer, be repeated within reasonable time and in accordance with the specified conditions. Pay to the Owner all reasonable expenses incurred by the Owner, including the costs of the Engineer, as a result of repeating such tests.

J. Post-Test Inspection: Once testing has been completed, all machines must be rechecked for proper alignment and realigned, as required. All equipment must be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies must be corrected to the satisfaction of the Engineer. All machines or devices that exhibit unusual or unacceptable operating characteristics must be disassembled and inspected. Any defects found during the course of the inspection must be repaired or the specific part

or entire equipment item must be replaced to the complete satisfaction of the Engineer, at no additional cost to the Owner.

K. After the Contractor has demonstrated and proven to the Engineer that all systems are functioning properly and have been documented in the approved testing and startup plan, then the Contractor may demonstrate this reliability to the Owner. The Owner demonstration must be executed as agreed upon and documented per the approved testing and startup plan.

3.6 COMMISSIONING

A. Commissioning will begin following completion of the system performance test as specified above and will continue until meeting the time frame and conditional requirements, as described below.

B. No system failures may have occurred during the time frame that would result in starting the commissioning over again.

C. The conditions listed below will constitute system failures of components that are considered critical to the operability and maintainability of the system. Any one of these failures will terminate Commissioning.

1. Failure to repair a hardware or software problem within 120 consecutive hours from the time of notification of a system failure.
2. Recurrent hardware problems: If the same type of problem occurs three times or more.
3. Following correction of the problem, a new commissioning time frame must begin.

D. The following conditions will constitute a minor system failure and may require correction and restarting Commissioning if too many have occurred too often, as to be judged by the Owner and Engineer:

1. Loss of communications between devices on the communications network.
2. Failure of one or more input/output components.
3. Failures of any type affecting ten or more input/output points simultaneously.
4. Failure of any type affecting one or more regulatory control loops or sequential control strategies thereby causing a loss of the automatic control of the process variable or process sequence operation.
5. Failure of power supply. Where redundant power supplies are provided, failure of one power supply shall not constitute a system

failure provided the backup power supply operates properly and maintains supply power. Failure of the backup supply to operate properly and maintain supply power shall constitute a system failure.

E. Completion of a 2 consecutive day period without any restarts of the commissioning and, with agreement of the Owner and Engineer, will constitute acceptance of the System by Owner.

F. All parts and maintenance materials required to repair the system prior to completion of the commissioning are to be supplied by Contractor, at no additional cost to Owner. If parts are obtained from the contractual spare parts inventory, they shall be replaced to provide a full complement of spare parts as specified.

G. A System Malfunction/Repair Reporting Form must be completed by the Owner and Engineer to document system failures, to record Contractor notification, and Contractor repair actions. Format of the form shall be developed and agreed upon prior to the start of the commissioning.

****END OF SECTION****

SECTION 017843

SPARE PARTS AND MAINTENANCE MATERIALS

PART 1 -GENERAL

1.1 DESCRIPTION

A. The Contractor must furnish spare parts and maintenance material for the equipment as stated in the equipment specifications.

B. The Contractor to provide spare parts data and maintenance material, including a complete list of parts and supplies, with current unit prices and source(s) of supply, within ninety (90) days after approval of the shop drawing for each piece of equipment.

C. Spare parts and materials required to be supplied in the Contract Documents must be:

1. Furnished in manufacturer's unopened cartons, boxes, crates, or other protective covering suitable for preventing corrosion or deterioration for the maximum length of storage that may be normally anticipated.
2. Clearly marked and identified as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten (10) years.
3. Stored in buildings or trailers with floor, roof, and closed sides and in accordance with manufacturer's recommendations. Protect from weather, condensation, and humidity.
4. Delivered to the Owner upon Substantial Completion of the Work, or start-up and place them in permanent storage rooms or areas approved by the Owner. The turnover procedures are to be agreed upon by the Owner, Engineer, and Contractor.

D. Provide transmittal letter or email and spare parts receiver form including the following:

1. Date of letter and transfer of parts and material
2. Project title and number
3. Contractor's name and address
4. List of applicable specification sections for each set of spare parts supplied

5. Spare Parts Form – see sample form provided

PART 2 -MATERIALS (NOT USED)

PART 3 -EXECUTION (NOT USED)

SPARE PARTS RECEIVER FORM
PROJECT NAME AND NUMBER
PER SPECIFICATION SECTION 017843

CONTRACTOR TO FILL OUT:

MANUFACTURER:_____

ITEM DESCRIPTION:_____

COST:_____

MANUFACTURER PART NUMBER:_____

SUPPLIER:_____

CROSS REFERENCE NUMBER:_____

VENDOR INFORMATION:_____

VENDOR ORDER PART NUMBER:_____

PART TO BE USED ON

WHAT EQUIPMENT:_____

_____

EQUIPMENT NUMBER:_____

SPECIFICATION SECTION:_____

OWNER PERSONNEL FILL IN:

BIN NUMBER:_____

AIMS NUMBER:_____

LOCATION IN STORES:_____

RECEIVED BY:_____

END OF SECTION

SECTION 017900

DEMONSTRATION AND TRAINING

PART 1 -GENERAL

1.1 DESCRIPTION

A. Provide the services of factory-employed or factory-trained maintenance specialists to instruct Owner's operations and maintenance personnel in the recommended operation and preventative maintenance procedures for equipment specified in the equipment Sections.

B. Related Sections:

1. Submittals in Section 013300.
2. Equipment and System Start-up and Performance Testing in Section 017516.

1.2 SUBMITTALS

A. Follow requirements for submittals in Section 013300.

B. Submit for approval for each major manufacturer's equipment item or system:

1. Proposed Lesson Plan for each scheduled instruction thirty (30) days prior to commencement of training. Lesson plans must be approved a minimum of seven (7) days prior to scheduled instruction.
2. Credentials of their designated operations and maintenance instructor. Credentials must include a brief resume and specific details of the instructor's experience pertaining to operation of, maintenance of, and training for the equipment specified.
3. Training Request Form: Contractor must submit the Training Request Form to the Engineer and Owner fourteen (14) days prior to the requested training date.

1.3 GENERAL REQUIREMENTS

A. The qualifications of specialists are subject to approval by Engineer.

B. Contractor will coordinate these services at times acceptable to Owner and Engineer, with a minimum of seven (7) days prior notice.

C. Manufacturer will provide a combination of classroom and field training. All training to be conducted at the Facility, unless otherwise stated in the equipment Sections or agreed to by Owner. Class size may be limited

based on Manufacturer input or availability of plant Operations. Manufacturer will provide training for all plant shifts, or as approved by Owner.

D. Manufacturer will allow any and all training sessions to be videotaped by Owner.

E. Section 017516, Equipment and System Startup and Performance Testing, include additional requirements for manufacturer's and supplier's field and test data.

F. Instruction of Owner's personnel may commence only after the equipment has been started, approved Operation and Maintenance Manuals have been turned over to the Owner, and acceptance tests have been completed according to the provisions Section 017516, Equipment and System Startup and Performance Testing.

G. Contractor shall submit a copy of this Section to all manufacturers of equipment for this Contract.

1.4 TRAINING SCHEDULE

A. Each manufacturer must provide training as required in the equipment specification section. In under all circumstances, manufacturer must provide sufficient training time to fully cover all equipment start-up, operation, and maintenance requirements. Travel time and expenses are the responsibility of the manufacturer and are not included in training schedule time.

1.5 INSTRUCTIONAL LESSON PLAN

A. Provide the approved Instruction Lesson Plan, and include the following as a minimum:

1. Equipment Operation:
    a. Describe equipment's operating (process) function.
    b. Describe equipment's fundamental operating principals and dynamics, including use of flow diagrams, operating sequence diagrams, wiring diagrams, and controls narratives as appropriate.
    c. Identify equipment's mechanical, electrical and electronic components and features.
    d. Identify all support equipment associated with the operation of subject equipment (e.g., air intake filters, valve actuators, motors).

e. Recommend standard operating procedures to cover start-up, routine monitoring, emergency operation, and shutdown of the equipment.

f. Explain use of control equipment, including temperature settings, switch modes, and available adjustments.

2. Detailed Component Description:

   a. Identify and describe in detail each component's function.

   b. Where applicable, group related components into subsystems. Describe subsystem functions and their interaction with other subsystems.

   c. Identify and describe in detail equipment safeties and control interlocks.

3. Equipment Preventive Maintenance (PM):

   a. Describe PM inspection procedures required to:

      i. Perform an inspection of the equipment in operation.

      ii. Spot potential trouble symptoms and anticipate breakdowns.

      iii. Forecast maintenance requirements (predictive maintenance).

   b. Identify items requiring periodic maintenance and define the recommended PM intervals for each component.

   c. Provide lubricant and replacement part recommendations and limitations.

   d. Describe appropriate cleaning practices and recommend intervals.

   e. Identify and describe the use of special tools required for maintenance of the equipment.

   f. Describe component removal/installation and disassembly/assembly procedures.

   g. Perform at least two "hands-on" demonstrations of preventive maintenance procedures.

   h. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

i. Define recommended torquing, mounting, calibration and/or alignment procedures and settings, as appropriate.

j. Describe recommended procedures to check/test equipment following a corrective repair.

k. Identify functions/components that must be serviced only by authorized factory representatives.

4. Equipment Troubleshooting:

a. Define recommended systematic troubleshooting procedures.

b. Provide component-specific troubleshooting checklists.

c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.

d. Demonstrate commonly occurring problems and corresponding troubleshooting procedures.

5. Manufacturer's proposed Lesson Plan will detail specific instruction topics. Training aids to be utilized in the instruction must be referenced and attached where applicable to the proposed Lesson Plan. "Hands-On" demonstrations planned for the instruction must be described in the Lesson Plan.

6. The manufacturer will indicate the estimated duration of each segment of the training Lesson Plan.

1.6 TRAINING AIDS

A. The manufacturer's instructor will incorporate training aids as appropriate to assist in the instruction. As a minimum, the training aids must include text and figure handouts. Other appropriate training aids include:

1. Audio-Visual Aids (e.g., films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, catalogue sheets).

2. Equipment cutaways and samples (e.g., spare parts and damaged equipment).

3. Tools (e.g., repair tools, customized tools, measuring and calibrating instruments).

B. The manufacturer's instructor will utilize descriptive class handouts during the instruction. Photocopied class handouts must be good quality reproductions. Class handouts should accompany the instruction with frequent reference made to them. Customized handouts developed

especially for the instruction are encouraged. Handouts planned for the instruction must be attached with the manufacturer's proposed Lesson Plan.

1.7 "HANDS-ON" DEMONSTRATIONS

A. The manufacturer's instructor shall present "hands-on" demonstrations of operations and maintenance of the equipment for each scheduled group. The proposed "hands-on" demonstrations should be described in the manufacturer's proposed Lesson Plan.

B. Demonstrate operation through complete control cycle and full range of operation in all modes, including testing and adjusting relevant to operation.

C. Furnish all tools required for demonstration.

PART 2 -MATERIALS (NOT USED)

PART 3 -EXECUTION (NOT USED)

TRAINING REQUEST FORM
PROJECT NAME AND NUMBER
PER SPECIFICATION SECTION 017900

Equipment Name:_____

Equipment Tag Number:_____

Equipment Description:_____

Specification Section:_____

Operations and Maintenance Date Submitted / Approved:_____

Start-up and Testing Complete/Date:_____

Lesson Plan Submitted/Approved:_____

Training Aids Submitted/Approved:_____

Hands-on Demonstration:_____

Training Schedule (Dates, Time, No. of Sessions):_____

_____

_____

_____

END OF SECTION