City of Galveston
823 Rosenberg Street
Galveston, TX 77553

CONTRACT DOCUMNTS & TECHNICAL SPECIFICATIONS

FOR

PIRATES BEACH WASTEWATER TREATMENT PLANT REPLACMENT

VOLUME 1 OF 1

Prepared By:

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

Texas Registered Engineering Firm F-2614

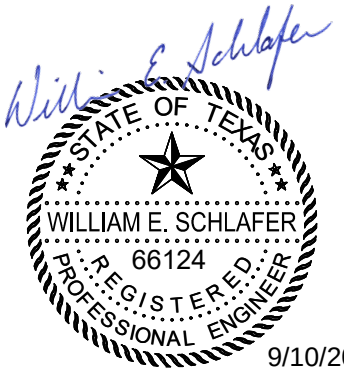
2925 Briarpark Drive, Suite 400
Houston, Texas 77042
Phone: 713-266-6900

Issued for Bid
September 2021

CITY OF GALVESTON, TEXAS

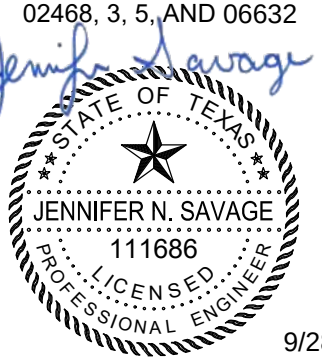
ENGINEER & ARCHITECT SEALS

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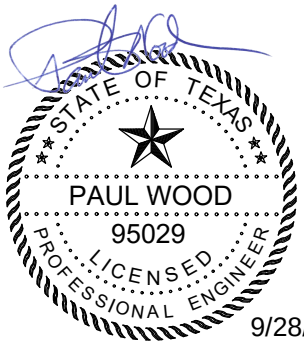
9/10/2021

DIVISION:
02468, 3, 5, AND 06632



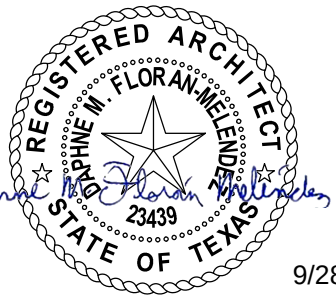
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09928, 11, 13405, 13421, 15071, 15075, 15138, AND 15139



9/28/2020

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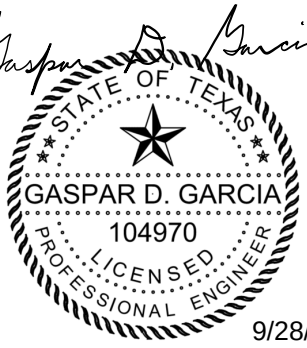
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9/28/2020

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

PIRATES BEACH WASTEWATER TREATMENT PLANT REPLACEMENT

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ATTACHMENTS

Attachment A – Geotechnical Report, June 2, 2017 &
Supplemental Geotechnical Report, May 8, 2020

The information contained and/or included in this Exhibit was prepared by a third party. In return for Contractor's use of this information, Contractor acknowledges and agrees: (1) the information was not created or prepared for the Contractor; (2) the information is being provided "as-is" and neither the Engineer nor the Owner have or can verify the accuracy of the information. The Contractor shall be solely responsible for verifying the accuracy of the information; and (3) To the extent allowable under law, neither the Engineer nor the Owner shall be responsible for any claims, damages or costs (including reasonable attorney's fees) arising or resulting from any use of or reliance on the information in any way.

END OF SECTION

City of Galveston

REQUEST FOR PROPOSAL

Proposal Reference Number: RFP 22-02

Project Title: Pirates Beach Wastewater Treatment Plant Replacement

Proposal Closing Date: 10:00 A.M.(CST), Wednesday, December 15, 2021

Electronic submittals are required: UPLOAD SUBMITTAL HERE

No Proposals submitted after the above deadline will be accepted.

Contact: City of Galveston Purchasing Division at purchasing@galvestontx.gov or 409-797-3579.

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Galveston, Texas
Request for Proposal

1. Introduction

A. Project Overview: The City of Galveston is requesting proposals with the intent of awarding a contract for the purchase of goods and services contained in Appendix J – Scope of Services.

B. Questions: Following are contacts for questions as identified.

i. RFP Clarifications: All questions related to requirements or processes of this RFP should be submitted in writing to the Purchasing Division. Contact information provided in section 2 below.

ii. Scope of Service Questions: All questions related to the scope of services should be submitted in writing to the contact person(s) noted in Appendix J – Scope of Services.

iii. Replies: Responses to inquiries which directly affect an interpretation or effect a change to this RFP will be issued in writing by addendum and posted to City website. All such addenda issued by City prior to the submittal deadline shall be considered part of the RFP. The City shall not be bound by any reply to an inquiry unless such reply is made by such formal written addendum.

iv. Acknowledgement of Addenda: The Proposer must acknowledge all addenda by signing and returning such document(s) or by initialing appropriate area of the proposal document or the submittal will be considered Non-Responsive.

C. Notification of Errors or Omissions: Proposers shall promptly notify the City of any omissions, ambiguity, inconsistency or error that they may discover upon examination of this RFP. The City shall not be responsible or liable for any errors and/or misrepresentation that result from the solicitations which are inadvertently incomplete, ambiguous, inconsistent or obviously erroneous.

D. Conflict of Interest Questionnaire (Form CIQ): A person or business, and their agents, who seek to contract or enter into an agreement with the City, are required by Texas Local Government Code, Chapter 176, to file a conflict of interest questionnaire (FORM CIQ) which is found in Appendix B. The form must be filed with the City Secretary no later than seven (7) days after the date the person or business begins contract discussions or negotiations with the City, or submits an application, response to a request for proposals or proposals, correspondence, or other writing related to any potential agreement with the City. If no conflict exists the offeror must mark the form Not Applicable or NA and return with the proposal packet.

E. Disclosure of Interested Parties Form 1295: A person or business, who enters into a contract with the City, meeting the conditions according to Texas Local Government Code Sec. 2252.908, is required to file Form 1295 with Texas Ethics Commission. **This form is not required unless there is a contract between the vendor and the City of Galveston. Do not submit this form unless you receive an award letter from the City.**

2. Contact Information

Mailing Address: City of Galveston, Purchasing Division, Room 300, PO Box 779, Galveston, Texas 77553

Physical Address: City of Galveston, Purchasing Division, 823 Rosenberg Street, Room 300, Galveston, Texas 77550

Email Address: purchasing@galvestontx.gov

3. General Information

A. Tax Exempt Status: City purchases are exempt from State Sales Tax and Federal Excise Tax. Do not include tax in the proposal. City will furnish Excise Tax Exemption Certificate upon request.

B. Public Inspection of Proposals: The City strictly adheres to the Texas Public Information Act (Texas Government Code Chapter 552.001, et seq.) and all other governing statutes, regulations, and laws regarding the disclosure of RFP information. Proposal Documents are not available for public inspection until after the contract award. If the Proposer has notified the City, in writing, that the Proposal Document contains trade secrets or confidential information, the City will generally take reasonable steps to prevent disclosure of such information, in accordance with the Public Information Act. This is a statement of general policy only, and in no event shall the City be liable for disclosure of such information by the City in response to a request, regardless of the City's failure to take any such reasonable steps, even if the City is negligent in failing to do so.

The requirements of Subchapter J, Chapter 552, Government Code, may apply to this solicitation and the contractor or vendor agrees that the contract can be terminated if the contractor or vendor knowingly or intentionally fails to comply with a requirement of that chapter. Vendor or contractor acknowledges that the solicitation is part of any resulting contract of the solicitation, as Exhibit A.

C. All Proposers are hereby put on notice that if the Proposer is awarded a contract for procurement of goods or services, the City of Galveston is entering into that contract in its governmental capacity, and not a proprietary capacity.

D. The City of Galveston is required to verify, that company does not do business with Iran, Sudan, or any Foreign Terrorist Organization, pursuant to Texas Government Code, Chapter 2252, Section 2252.152, and Section 2252.153.

E. Pursuant to Texas Government Codes Chapters 880, 2270, Sections 880.001, 2270.001, and 2270.002; vendor is required to complete Appendix C (certifying that company does not Boycott Israel), in the solicitation document, if company has greater than 10 employees and/or the value of a contract resulting from the solicitation is valued at $100,000 or greater.

F. Pursuant to Chapter 2274, Texas Government Code, Contractor verifies (1) it does not boycott energy companies, and (2) it will not boycott energy companies during the term of this Agreement. Contractor acknowledges this Agreement may be terminated and payment withheld if this verification is inaccurate. (Note: This provision only applies in a contract that (1) has a value of $100,000 or more that is to be paid wholly or partly from public funds and (2) is with a for-profit entity, not including a sole proprietorship, that has ten (10) or more full-time employees.)

G. In accordance with Texas Government Code Chapter 2274, Contractor verifies that it does not have a practice, policy, guidance or directive that discriminates against a firearm entity or firearm trade association; and will not discriminate during the term of the contract against a firearm entity or firearm trade association. This section only applies if: (i) Contractor has ten (10) or more full-time employees and (ii) this Agreement has a value of $100,000 or more to be paid under the terms of this Agreement; and does not apply: (i) if Contractor is a sole proprietor, a non-profit entity, or a governmental entity; (ii) to a contract with a sole-source provider; or (iii) to a contract for which none of the bids from a company were able to provide the required certification.

4. RFP Withdrawals and/or Amendments

A. RFP Withdrawal: The City reserves the right to withdraw this RFP for any reason.

B. RFP Amendments: The City reserves the right to amend any aspect of this RFP by formal written Addendum prior to the Proposal submittal deadline and will endeavor to notify all potential Proposers that have notified the Purchasing Division of their intent to Proposal, but failure to notify shall impose no obligation or liability on the City.

5. Estimated Quantities

An award of a contract to a vendor(s) does not guarantee the vendor(s) that the City shall issue any Purchase Orders for the offeror's goods or services, or guarantee any particular volume use, number, or sales.

6. Proposal Submittal Requirements

A. Submittal Packet – How to submit: All Proposals must be submitted electronically. No Proposal will be accepted by mail or hand delivery. Proposals submitted by mail or hand delivery will be marked non-responsive. Submittals shall be submitted through the City of Galveston online portal at the URL address indicated in Appendix J. 3. Scope of Services – Special Conditions.

B. Submittal Packet – Required Contents: All items in this Proposal are considered part of the Proposal package. Submittals must include the package in its entirety; signed in the appropriate places by an authorized representative of the company with an original signature. Proposals not including all of the above will be considered non-responsive. Offerors must submit their Proposals on the forms provided herein, otherwise, it will be marked non-responsive.

C. Submittal Deadline: The deadline for submittal of Proposals shall be as identified on the title of the Proposal and on page 9 (nine) of Appendix A-Proposal. It is the Offeror's responsibility to have the Proposal Documents, including Addenda, correctly submitted by the submittal deadline. No extensions will be granted and no late Proposals will be accepted.

D. Proposals Received Late: Proposers are encouraged to submit their Proposals as soon as possible. The time and date of receipt as recorded in the Purchasing Office, by the City's online submittal portal, shall be the official time of receipt. The City is not responsible for late submission regardless of the reason. Late Proposals will not be considered under any circumstances.

E. Alterations or Withdrawals of Proposal Document: Any submitted Proposal may be withdrawn or a revised Proposal substituted prior to the submittal deadline. Proposal Documents cannot be altered, amended or withdrawn by the Proposer after the submittal deadline.

F. Proposal Document Format: All proposal Documents must be prepared in single-space type, on standard 8-1/2" x 11" vertically oriented pages, numbered at the bottom, with the exception of plans or drawings, those may be submitted landscape on 8-1/2" x 11" pages. ***The package must be in the order required in the Scope of Services.*** The submittal must be written in pen or typed, signatures must be signed in pen, or a digital signature via the electronic submittal process, and anything written in pencil will not be accepted. Mistakes can be crossed out and corrections inserted and initialed by the individual signing the proposal. The City only accepts proposals that are submitted through the online portal. The link is provided on the title page of this document and in Appendix J. 3. Scope of Work – Special Conditions. No hand delivered or mailed submittals will be considered and will be marked "Non-responsive".

G. Questions and Responses: Questions regarding proposals must be addressed to the Purchasing Division UPLOAD QUESTIONS HERE. The subject line must read "**RFP 22-02 Pirates Beach Wastewater Treatment Plant Replacement**". The question deadline will be addressed in Appendix J-Scope of Services. Responses will be answered after the question deadline in the form of an Addendum. No responses will be given to questions submitted after the deadline. Questions submitted outside of the Purchasing Division will not be answered and any communication with a User Department prior to award by City Council will disqualify a vendor from being considered for award.

H. Pre-Proposal Conferences: The date and time of a pre-proposal conference, if necessary, will be found in Appendix J-Scope of Services.

I. Validity Period: Once the submittal deadline has passed, any proposal Document shall constitute an irrevocable proposal to provide the commodities and/or services set forth in the Scope of Services at the price(s) shown in the Proposal Document. Such proposal shall be irrevocable until the earlier of the expiration of ninety (90) days from the submittal deadline, or until a contract has been awarded by the City.

7. Proposal Evaluation and Contract Award

A. Proposal Evaluation and Contract Award Process: An award of a contract to provide the goods or services specified herein will be made using competitive sealed proposals, in accordance with Chapter 252 of the Texas Local Government Code and with the City's purchasing policy. The City will evaluate all proposals to determine which offerors are reasonably qualified for the award of the contract, applying the anticipated evaluation factors and emphasis to be placed on each factor as identified in the Scope of Services. A variety of factors may be used in the evaluation of the submitted proposals for this project. The City may, at its option, conduct discussions with or accept proposal revisions from any reasonably qualified proposer. Discussions may not be initiated by offerors. **These discussions will be limited to issues and topics brought forth by the City. Any attempt by proposer or vendor at deviating from the issues and topics to discuss other issues and topics concerning the Proposal brought forth by the City of Galveston shall be grounds for disqualification.** Vendors shall not contact any City of Galveston personnel during the proposal process without the express permission from the City's Purchasing Supervisor.

B. All correspondence relating to this proposal, from advertisement to award, shall be sent to the City of Galveston's Purchasing Division. All presentations and/or meetings between the City of Galveston and the vendor relating to this proposal shall be coordinated by the City of Galveston Purchasing Division. The City reserves the right to determine which proposal provides the City with the best value and which will be in the City's best interest.

C. Completeness: If the Proposal Document is incomplete or otherwise fails to conform to the requirements of the RFP, the City alone will determine whether the variance is so significant as to render the Proposal non-responsive.

D. Ambiguity: Any ambiguity in the Proposal Document as a result of omission, error, lack of clarity or non-compliance by the Proposer with specifications, instructions and all conditions shall be construed in the favor of the City. In the event of a conflict between these standard RFP requirements and details provided in Appendix J – Scope of Services or Appendix A – Proposal, the Appendices shall prevail.

E. Unit Prices and Extensions: If unit prices and their extensions do not coincide, the City may accept the price most beneficial to the City, and the Proposer will be bound thereby.

F. Additional Information: City may request any other information necessary to determine Proposer's ability to meet the minimum standards required by this RFP.

G. Partial Contract Award: City reserves the right to award one contract for some or all the requirements proposed or award multiple contracts for various portions of the requirements to different Proposers based on the unit prices proposed in response to this request, or to reject any and all Proposals and re-solicit for Proposals, as deemed to be in the best interest of City.

H. No Commitment: The Request for Proposal does not commit the City of Galveston to award any costs or pay any costs, or to award any contract, or to pay any costs associated with or incurred in the preparation of a (Proposal/proposal) to this request, or to procure or contract for services or supplies.

I. Protest Procedures: Any actual or prospective offeror who is allegedly connected with the solicitation or award of an offer may protest. The protest will be submitted in writing to the City of Galveston's Purchasing Division within three working days after such aggrieved person knows of, or should have known of the facts giving rise thereto. If the protest is not resolved by mutual agreement, the Purchasing Division will promptly issue a decision in writing, via electronic mail, to the protesting person.

   i. All protest lodged by potential or actual bidders, contractors or proposers must be made in writing, via electronic mail, and contain the following information:
      a. Name, address and telephone number of the protestor.
      b. Identification of the solicitation or contract number and time.
      c. A detailed statement of the protest's legal and factual grounds, including copies of relevant documents.
      d. Identification of the issue(s) to be resolved and statement of what relief is requested.
      e. Arguments and authorities in support of the protest.
      f. A statement that copies of the protest have been delivered, via electronic mail, to all interested parties in the invitation to bid or request for proposals process.

ii. In the case of request for proposals, the City of Galveston Purchasing Supervisor shall ask the protester deliver, via electronic mail, the protest to relevant parties.
iii. The City of Galveston's City Manager has the authority to render the final determination regarding the protest. Any determination rendered by the City of Galveston's City Manager will be final.

J. Single Proposal Response: If only one bid or proposal is received in response to the Request for Proposal/Bid, a detailed cost proposal may be requested of the single contractor. A cost/price analysis and evaluation and/or audit may be performed of the cost proposal in order to determine if the price is fair and reasonable.

K. Re-Appropriation of Budget Items: The City may reduce the funds allocated and the services required under this Agreement at its discretion. The City shall notify Contractor in writing of this reduction. Contractor shall not perform any services subtracted from this Agreement. The de-obligation of funds does not require any formal amendment of this Agreement but shall be evidenced by a revised budget approved by City Council.

L. Appropriation of Funds: The City of Galveston has established an appropriation (allocation) of funds for this project, if in the event that appropriated (allocated) funds are exhausted, the contractor's only remedy shall be suspension or termination of its performance under this contract and shall have no other remedy in law or in equity against the City and no right to damages of any kind.

M. Terminate for Cause: The occurrence of any one or more of the following events will justify termination of the contract by the City of Galveston for cause:

i) The successful Proposer fails to perform in accordance with the provisions of these specifications; or

ii) The successful Proposer violates any of the provisions of these specifications; or

iii) The successful Proposer disregards laws or regulations of any public body having jurisdiction; or

iv) The successful Proposer transfers, assigns, or conveys any or all of its obligations or duties under the contract to another without written consent of the City.

v) If one or more of the events identified in Subparagraphs M i) through iv) occurs, the City of Galveston may, terminate the contract by giving the successful Proposer seven (7) days written notice of such termination. In such case, the successful Proposer shall only be entitled to receive payment for goods and services provided before the effective date of termination. The successful Proposer shall not receive any payment on account of loss of anticipated profits or revenue or other economic loss resulting from such termination.

vi) When the contract has been so terminated by the City of Galveston, such termination shall not affect any rights or remedies of the City then existing or which may thereafter accrue.

J. Terminate for Convenience: This contract may be cancelled or terminated at any time by giving vendor thirty (30) days written notice. Vendor may be entitled to payment for services actually performed prior to termination; to the extent said services are satisfactory.

8. Pursuant to Sec. 2-341 of the City Code – Declaration of Policy

A. It is the policy of the City of Galveston to stimulate growth of local minority and women-owned business enterprise (M/WBE) by encouraging their participation in all phases of its contract and procurement activity and by affording them the opportunity to compete for all City of Galveston contracts. The purpose and objectives of this article are to:

   i. Increase the capacity of local M/WBE's to provide products and services.
   ii. Increase the opportunities for local M/WBE's to expand their business with the city and other public and private sector business entities.

B. Provided, however, nothing herein shall require the city to award contracts for services or procurements to a M/WBE which is not also the lowest responsive and responsible Proposer and otherwise qualified unless the city may otherwise lawfully award the contract to someone other than the lowest responsive, responsible Proposer.

C. Additionally, The City of Galveston has a Disadvantaged Business Enterprise, (DBE) program mandated by the US Department of Transportation, which is part of its M/WBE program.

Appendix A – Proposal Document

Submittal Checklist: (To determine validity of offer)

_____Appendix A (pages _11_ through _20_) must be included in the submittal.

_____Appendix B – G (pages_21_ through _27_) all forms must be complete and included in the submittal.

By checking the below box(es), you are acknowledging the contents of the document(s) relating to the listed appendices, and agreeing to their terms:

- ☐ Appendix B – Conflict of Interest
- ☐ Appendix C – House Bill 89 Verification
- ☐ Appendix D – Property Tax Statement
- ☐ Appendix E – Nepotism Statement
- ☐ Appendix F – Non-Collusion Statement
- ☐ Appendix G – Certification Regarding Debarment
- ☐ Appendix J – Scope of Work
- ☐ Appendix K – Federal Clauses

_____Appendix J (pages_31_ through _32_) must be included in the submittal.

_____Appendix K (pages_33_ through _43_) all pages must be included in the submittal.

All proposals submitted to the City of Galveston shall include this page with the submittal.			
RFP Number:	**22-02**		
Project Title:	**Pirates Beach Wastewater Treatment Plant Replacement**		
Submittal Deadline:	**10:00 A.M.(CST), Wednesday, December 15, 2021**		
Submit Electronically: UPLOAD SUBMITTAL HERE			
Offeror Information:			
Offeror's Legal Name:			
Address:			
City, State & Zip			
Federal Employers Identification Number #			
Phone Number:		**Fax Number:**	
E-Mail Address:			

Offeror Authorization

I, the undersigned, have the authority to execute this Offer in its entirety as submitted and enter into a contract on behalf of the Offeror.

Printed Name and Position of Authorized Representative: _____

Signature of Authorized Representative: _____

Signed this _____(day) of _____(month),_____(year)

I. ***REQUIRED PROPOSAL INFORMATION. IN ORDER FOR A PROPOSAL TO BE CONSIDERED COMPLETE, AND TO BE EVALUATED FOR A CONTRACT AWARD BY THE CITY, PROPOSER MUST SUBMIT ALL OF THE FOLLOWING INFORMATION***

1. Proposed Products and/or Services

A. Product or Service Description: Proposers should utilize this section to describe the technical aspects, capabilities, features and options of the service or product and/or service proposed in accordance with the required Scope of Services as identified in Appendix J. Promotional literature, brochures, or other technical information may be used.

B. Additional Hardware Descriptions: Proposers should also include in this section a detailed description of what additional hardware and/or software, if any, would be required by the City in order to fully utilize the goods and/or services proposed.

C. Guarantees and Warranties: Each Proposer shall submit a complete copy of any warranties or guarantees provided by the manufacturer or Proposer with the Proposal submitted.

D. Project Schedule/Delivery Date: Proposer must provide a project schedule noting all projected completion dates for segments of the Project, from start-up to completion, and all delivery dates for goods covered by the RFP. The Proposal Document must show the number of days required to deliver and install the product or equipment after the receipt of the City's Purchase Order.

2. Cost of Proposed Products and/or Services

A. Pricing: Pricing shall reflect the full Scope of Services defined herein, inclusive of all associated cost for delivery, labor, insurance, taxes, overhead, and profit.

B. Pricing Form: The pricing form, in Appendix J.7. Scope of Services, will be considered the official pricing form for this solicitation. No other pricing will be considered or accepted as a part of the contract for goods or services for this solicitation. All pricing provided outside the official pricing form included will be void and will not be considered during any evaluation by the City of Galveston.

3. Term of Contract:

Any contract resulting from this RFP shall be effective upon execution by the City of Galveston. The City anticipates that contract shall be renewed pursuant to the availability of funds and at the discretion of the City.

4. Proposer's Experience / Staff

A. Project Team: Identify all members of the Proposer's team (including both team members and management) who will be providing any services proposed and include information which details their experience.

B. Removal or Replacement of Staff: If an assigned staff person must be removed or replaced for any reason, the replacement person must be approved by City prior to joining the project.

C. Business Establishment: State the number of years the Proposer's business has been established and operating. If Proposer's business has changed names or if the principals

operating the business operate any similar businesses under different names, or have operated any other businesses or changed the legal status or form of the business within the last five (5) years, all names, of predecessor business names, affiliated entities, and previous business entities operated by the principals, if different than present, must be provided;

State the number of years' experience the business has: _____; and the number of employees: _____.

D. Project Related Experience: All Bids must include detailed information that details the Proposer's experience and expertise in providing the requested services that demonstrates the Proposer's ability to logically plan and complete the requested project.

5. References

Proposer shall provide four (4) references where Proposer has performed similar to or the same types of services as described herein. Proposer shall provide references not affiliated with the City of Galveston, or any of its employees.

Reference #1:

Client / Company Name:	
Contact Name:	Contact Title:
Phone:	Email:
Date and Scope of Services Provided:	

Reference #2:

Client / Company Name:	
Contact Name:	Contact Title:
Phone:	Email:
Date and Scope of Services Provided:	

Reference #3:

Client / Company Name:	
Contact Name:	Contact Title:
Phone:	Email:
Date and Scope of Services Provided:	

Reference #4:

Client / Company Name:	
Contact Name:	Contact Title:
Phone:	Email:
Date and Scope of Services Provided:	

Reference #5:

Client / Company Name:	
Contact Name:	Contact Title:
Phone:	Email:
Date and Scope of Services Provided:	

6. Trade Secrets and/or Confidential Information

Trade Secrets and/or Confidential Information: This proposal ___ (does) ___ (does not) contain trade secrets and/or confidential information. If applicable, describe such trade secrets and confidential information, and the basis for your assertion that such material qualifies for legal protection from disclosure.

7. Federal, State and/or Local Identification Information

A. Centralized Master Bidders List registration number: _____.

B. Prime contractor HUB / MWBE registration number: _____.

C. An individual Proposer acting as a sole proprietor must also enter the Proposer's Social Security Number: #_____-_____-_____.

D. Dun and Bradstreet Number - Data Universal Numbering System (DUNS): _____.

E. All vendors contracting with the City of Galveston may be required to register, or have an active registration with the System for Award Management (SAM.gov). Registration is free. The System for Award Management (SAM) is the official registration required prior to bidding on a contract with any federal government agency, including local governments who receive federal funds. Registration must be completed prior to contract award by City Council. Registering online is accomplished on the SAM website here: https://www.sam.gov/portal/SAM/##11#1.

8. Emergency Business Services Contact Notice

During a natural disaster, or homeland security event, there may be a need for the City of Galveston to access your business for products or services after normal business hours and/or holidays. The City may request City employee pick up or vendor delivery of product or services.

For this purpose, a primary and secondary emergency contact name and phone number are required. It is critical the vendor's emergency contact information remains current. City shall be contacted by E-mail with any change to a contact name or phone number of these emergency contacts. Updates may be emailed to **purchasing@galvestontx.gov**.

All products or services requested during an emergency event are to be supplied as per the established contract prices, terms and conditions. The vendor shall provide the fee (pricing) for an after-hours emergency opening of the business, if any. In general, orders will be placed using a City of Galveston procurement card (Master Card) or City issued Purchase Order. The billing is to include the emergency opening fee, if applicable.

The contractor shall provide the names, phone numbers and fee (pricing), if any, for an after-hours emergency opening of the business listed below.

Business Name: _____

Contract #: _____

Description: _____

Primary Contact (Name): _____

Primary Contact Phone Numbers: Home: _____ Cell: _____

Secondary Contact (Name): _____

Secondary Contact Phone Numbers: Home: _____ ___ Cell: _____

After Hours emergency opening fee, if applicable: $_____

9. Cooperative Governmental Purchasing Notice

Other governmental entities maintaining interlocal agreements with the City, may desire, but are not obligated, to purchase goods and services defined in this RFP from the successful Proposer. All purchases by governmental entities, other than the City, will be billed directly to and paid by that governmental entity. The City will not be responsible for another governmental entity's debts. Each governmental entity will place their own orders with the successful Proposer and be responsible for ensuring full compliance with the RFP specifications. Prior to other governmental entities placing orders, the City will notify the successful Proposer of their intent.

Please indicate below if you will permit other governmental entities to purchase from your agreement with the City.

[ ] Yes, Others can purchase [ ] No, Only the City can purchase.

II. ***CONTRACT TERMS AND CONDITIONS. EXCEPT WHERE PROPOSER MAKES SPECIFIC EXCEPTION IN THE SUBMITTED PROPOSAL, ANY CONTRACT RESULTING FROM THIS RFP WILL CONTAIN THE FOLLOWING TERMS AND CONDITIONS, WHICH PROPOSER HEREBY ACKNOWLEDGES, AND TO WHICH PROPOSER AGREES BY SUBMITTING A PROPOSAL***:

1. Delivery of Products and/or Services

A. Payment Terms: Unless otherwise specified in the Scope of Services or otherwise agreed to in writing by the City, payment terms for the City are Net 30 days upon receipt of invoice. Refer to Texas Local Government Code 2251, Payment for Goods and Services. Otherwise known as the Prompt Payment Act. Send all invoices to City of Galveston Attention: Accounts Payable, PO Box 779, Galveston, Texas 77553 or email: accountspayable@galvestontx.gov. See Appendix I for ACH Payment Information, if you elect to receive your payments according to Appendix I, fill out the form and return with your documents.

B. Warranty of Products and Services: All products furnished under this contract shall be warranted to be merchantable and good quality and fit for the purposes intended as described in this Proposal, to the satisfaction of City and in accordance with the specifications, terms, and conditions of the Scope of Services, and all services performed shall be warranted to be of a good and workmanlike quality, in addition to, and not in lieu of, any other express written warranties provided.

C. Late Delivery or Performance: If Proposer fails to deliver acceptable goods or services within the timeframes established in the Project Schedule, the City shall be authorized to purchase the goods or services from another source and assess any increase in costs to the defaulting Proposer, who agrees to pay such costs within ten days of invoice.

D. FOB (delivery charges): All products offered shall be FOB final destination, with all delivery charges to be prepaid by the Proposer. The City does not accept C.O.D. or collect shipments. The contract price shall include all charges, including delivery, installation and set-up fees. All packing, crating, or other debris resulting from the delivery or set-up of the commodity purchased shall be removed and properly disposed by the successful Proposer at no additional cost to the City.

E. Title to Goods and Risk of Loss: For goods to be provided by Proposers hereunder, if any, the title and risk of loss of the goods shall not pass to City until City actually receives, takes possession, and accepts the goods and the installation of such goods, has tested the system, and determined that it is in good and acceptable working order.

F. Force Majeure: If by reason of Force Majeure either party shall be rendered unable, wholly or in part, to carry out its responsibilities under this contract by any occurrence by reason of Force Majeure, then the party unable to carry out its responsibility shall give the other party notice and full particulars of such Force Majeure in writing within a reasonable time after the occurrence of the event, and such notice shall suspend the party's responsibility for the continuance of the Forced Majeure claimed, but for no longer period. Force Majeure means acts of God, floods, hurricanes, tropical storms, tornadoes, earthquakes, or other natural disasters, acts of public enemy, acts of terrorism, sovereign conduct, riots, civil commotion, strikes or lockouts, and other causes that are not occasioned by either Party's conduct which by the exercise of due diligence the party is unable to overcome and which substantially interferes with operations.

G. Liquidated Damages: The parties agree that, if the Project is not completed within the time specified plus any extensions of time allowed pursuant thereto, the actual damages sustained by the Owner because of any such delay will be uncertain and difficult of ascertainment, and that the reasonably foreseeable value of the use of said project by the Owner would be the sum of $250.00 per calendar day. The Contractor therefore agrees to pay, and the Owner agrees to accept, as liquidated damages and not as a penalty, the sum of $250.00 per calendar pay for each day's delay in fully completing said

project beyond the time specified in the Contract and any extensions of such time allowed there under.

H. Change Orders: per Texas Local Government Code Sec. 252.048. CHANGE ORDERS.
(a) If changes in plans or specifications are necessary after the performance of the contract is begun or if it is necessary to decrease or increase the quantity of work to be performed or of materials, equipment, or supplies to be furnished, the governing body of the municipality may approve change orders making the changes.

(b) The total contract price may not be increased because of the changes unless additional money for increased costs is appropriated for that purpose from available funds or is provided for by the authorization of the issuance of time warrants.

(c) If a change order involves a decrease or an increase of $50,000 or less, the governing body may grant general authority to an administrative official of the municipality to approve the change orders.

(c-1) If a change order for a public works contract in a municipality with a population of 300,000 or more involves a decrease or an increase of $100,000 or less, or a lesser amount as provided by ordinance, the governing body of the municipality may grant general authority to an administrative official of the municipality to approve the change order.

(d) The original contract price may not be increased under this section by more than 25 percent. The original contract price may not be decreased under this section by more than 25 percent without the consent of the contractor.

Changes to the contract may not be made by either party without the consent of both parties and following all applicable laws, including, but not limited to the City Charter of Galveston or the State of Texas Local Government Code.

2. Miscellaneous

A. Independent Contractor: Proposer agrees that Proposer and Proposer's employees and agents have no employer-employee relationship with City. Proposer agrees that if Proposer is selected and awarded a contract, City shall not be responsible for the Federal Insurance Contribution Act (FICA) payments, Federal or State unemployment taxes, income tax withholding, Workers Compensation Insurance payments, or any other insurance payments, nor will City furnish any medical or retirement benefits or any paid vacation or sick leave.

B. Assignments: The rights and duties awarded the successful Proposer shall not be assigned to another without the written consent of the Purchasing Supervisor. Such consent shall not relieve the assigner of liability in the event of default by the assignee.

C. Liens: Proposer shall indemnify and save harmless the City against any and all liens and encumbrances for all labor, goods, and services which may be provided to the City by Proposer or Proposer's vendor(s), and if the City requests, a proper release of all liens or satisfactory evidence of freedom from liens shall be delivered to the City.

D. Gratuities / Bribes: Proposer certifies that no bribes in the form of entertainment, gifts, or otherwise, were offered or given by the successful Proposer, or its agent or representative, to any City officer, employee or elected representative, with respect to this RFP or any contract with the City, and that if any such bribe is found to have been made this shall be grounds for voiding of the contract

E. Financial Participation: Proposer certifies that it has not received compensation from the City to participate in preparing the specifications or RFP on which the Proposal is based and acknowledges that this contract may be terminated and/or payment withheld if this certification is inaccurate.

F. Required Licenses: Proposer certifies that he holds all licenses required by the State of Texas for a provider of the goods and/or services described by the Scope of Services herein.

G. Authority to Submit Proposal and Enter Contract: The person signing on behalf of Proposer certifies that the signer has authority to submit the Proposal on behalf of the Proposer and to bind the Proposer to any resulting contract.

H. Authority to Enter Contract – City: The City Manager is the only person authorized to execute contracts on behalf of the City. All signature pages must include "approved as to form" and be signed by the City Attorney before the City Manager will execute the contract. Neither department heads nor elected officials are authorized to sign any binding contracts or agreements prior to being properly placed on the City Councils agenda and approved in an open meeting. Department heads and other elected officials are not authorized to enter into any type of agreement or contract on behalf of the City of Galveston. Only the City Manager may enter into a contract on behalf of the City of Galveston as authorized by City Council and the City Charter. Additionally, department heads and other elected officials are not authorized to agree to any type of supplemental agreements or contracts for goods or services. Supplemental agreements are subject to review by the City's Legal Department prior to being signed by the City Manager, (City's authorized representative).

I. Compliance with Applicable Law: Proposer agrees that the contract will be subject to, and Proposer will strictly comply with, all applicable federal, state, and local laws, ordinances, rules, and regulations.

J. Non-Discrimination: During the performance of this contract, the contractor agrees as follows: (1) The contractor will not discriminate against any employee or applicant for employment because of race, age, disability, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants and employees are not discriminated against on the basis of race, age, disability, color, religion, sex or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause. (2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, age, disability, color, religion, sex or national origin. (3) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions as may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

3. Financial Responsibility Provisions

A. Insurance: The Proposer, consistent with its status as an independent contractor, shall carry, and shall require any of its subcontractors to carry, at least the following insurance in such form, with such companies, and in such amounts (unless otherwise specified in the Scope of Services, Appendix J) as City may require, naming the City of Galveston as the additional insured:

i. Worker's Compensation and Employer's Liability insurance, including All States Endorsement, to the extent required by federal law and complying with the laws of the State of Texas;

ii. Commercial General Liability insurance for at least One Million Dollars ($1,000,000) on a per occurrence basis, with a Two Million ($2,000,000) aggregate. Blanket Contractual Liability, Broad Form Property Damage, Personal Injury, Completed Operations/Products Liability, Premises Liability, Medical Payments, and Broad Form General Liability Endorsements;

iii. Comprehensive Automobile Liability insurance covering all owned, non-owned or hired automobiles to be used by the Contractor, with coverage at the minimum State of Texas requirements;

iv. Professional Liability, Errors and Omissions in an amount to be determined in the Scope of Services.

Insurance coverage shall be on an "occurrence basis"

B. **Indemnification:** In Accordance with State Law, the contractor agrees to indemnify, save, and hold harmless the City of Galveston, Texas, its employees, officials, and agents from any and all claims, actions, damages, lawsuits, proceedings, judgements, or liabilities, for personal injury, death, or property damage resulting from the acts or omissions of anyone under the contractor's supervision or control.

In the event of any cause of action or claim asserted by a party to this agreement or any third party, the City will provide the contractor with timely notice of such claim, dispute or notice. Thereafter, the contractor shall at its own expense, faithfully and completely defend and protect the City against any and all liabilities arising from this claim, cause of action, or notice.

i. Indemnity for Intellectual Property: Proposer hereby warrants that the use or sale of the products, materials and services delivered hereunder will not infringe on the rights of any trade secrets, patent, copyright, registered trademark, or other intellectual property by right covering such materials and the successful Proposer agrees to indemnify and hold harmless the City for any and all costs, expenses, judgments, and damages which the City may have to pay or incur.

C. **Bond Requirements:** If applicable, per the Scope of Work, prior to the commencement of work on this Project, Bidder shall deliver to the City the following bonds issued by a good and sufficient surety licensed by the State of Texas and satisfactory to the City, unless otherwise stated below:

i. Bid bonds are required for bids over $25,000.00 in the amount of 5% of the total bid amount. This must be issued by a good and sufficient surety licensed by the State of Texas and satisfactory to the City, or a Cashier's Check.

ii. A payment bond in the amount of 100% of the total contract amount insuring the full and prompt payment of all persons performing labor and/or furnishing materials in connection with this Project;

iii. A performance bond in the amount of 100% of the total contract amount insuring full, faithful, and prompt performance of the responsibilities contained in this contract within the time parameters provided herein; and

Appendix B – Form CIQ

INFORMATION REGARDING VENDOR CONFLICT OF INTEREST QUESTIONNAIRE

WHO: The following persons must file a Conflict of Interest Questionnaire with the City if the person has an employment or business relationship with an officer of the City that results in taxable income exceeding $2,500 during the preceding twelve – month period, or an officer or a member of the officer's family has accepted gifts with an aggregate value of more than $250 during the previous twelve – month period and the person engages
in any of the following actions:

1. contracts or seeks to contract for the sale or purchase of property, goods or services with the City, including any of the following:
   a. written and implied contracts, utility purchases, purchase orders, credit card purchases and any purchase of goods and services by the City;
   b. contracts for the purchase or sale of real property, personal property including an auction of property;
   c. tax abatement and economic development agreements;
2. submits a Proposal to sell goods or services, or responds to a request for proposal for services;
3. enters into negotiations with the City for a contract; or
4. applies for a tax abatement and/or economic development incentive that will result in a contract with the City

THE FOLLOWING ARE CONSIDERED OFFICERS OF THE CITY:

1. Mayor and City Council Members;
2. City Manager;
3. Board and Commission members and appointed members by the Mayor and City Council;
4. Directors of 4A and 4B development corporations;
5. The executive directors or managers of 4A and 4B development corporations; and
6. Directors of the City of Galveston who have authority to sign contracts on behalf of the City.

EXCLUSIONS: A questionnaire statement need not be filed if the money paid to a local government official was a political contribution, a gift to a member of the officer's family from a family member; a contract or purchase of less than $2,500 or a transaction at a price and subject to terms available to the public; a payment for food, lodging, transportation or entertainment; or a transaction subject to rate or fee regulation by a governmental entity or agency.

WHAT: A person or business that contracts with the City or who seeks to contract with the City must file a "Conflict of Interest Questionnaire" (FORM CIQ) which is available online at www.ethics.state.tx.us and a copy of which is attached to this guideline. The form contains mandatory disclosures regarding "employment or business relationships" with a municipal officer. Officials may be asked to clarify or interpret various portions of the questionnaire.

WHEN: The person or business must file:

1. the questionnaire – no later than seven days after the date the person or business begins contract discussions or negotiations with the municipality, or submits an application, responds to a request for proposals or Proposals, correspondence, or other writing related to a potential contract or agreement with the City; and
2. an updated questionnaire – within seven days after the date of an event that would make a filed questionnaire incomplete or inaccurate.

It does not matter if the submittal of a Proposal or proposal results in a contract. The statute requires a vendor to file a FORM CIQ at the time a proposal is submitted or negotiations commence.

WHERE: The vendor or potential vendor must mail or deliver a completed questionnaire to the Finance Department. ***The Finance Department is required by law to post the statements on the City's website.***

ENFORCEMENT: Failure to file a questionnaire is a Class C misdemeanor punishable by a fine not to exceed $500. It is an exception to prosecution that the person files a FORM CIQ not later than seven business days after the person received notice of a violation.

NOTE: The City does not have a duty to ensure that a person files a Conflict of Interest Questionnaire.

CONFLICT OF INTEREST QUESTIONNAIRE — FORM CIQ

For vendor or other person doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 1491, 80th Leg., Regular Session.

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

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

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

OFFICE USE ONLY

Date Received

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

2. ☐ **Check this box if you are filing an update to a previously filed questionnaire.**

(The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)

3. Name of local government officer with whom filer has employment or business relationship.

_____
Name of Officer

This section (item 3 including subparts A, B, C & D) must be completed for each officer with whom the filer has an employment or other business relationship as defined by Section 176.001(1-a), Local Government Code. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer named in this section receiving or likely to receive taxable income, other than investment income, from the filer of the questionnaire?
☐Yes ☐No

B. Is the filer of the questionnaire receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer named in this section AND the taxable income is not received from the local governmental entity?
☐Yes ☐No

C. Is the filer of this questionnaire employed by a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership of 10 percent or more?
☐Yes ☐No

D. Describe each employment or business relationship with the local government officer named in this section.

4.

_____ _____
Signature of person doing business with the governmental entity — Date

Adopted 06-29-2007

THIS DOCUMENT MUST BE COMPLETED AND SUBMITTED AS IT IS A PART OF THE SOLICITATION PACKAGE AS MENTIONED IN SECTION 6B OF THE PROPOSAL.

Appendix C - House Bill 89, 13, 19 Verification

Pursuant to Sections 2270.001, 2270.002, 808.001, Texas Government Code:

1. *"Boycott Israel" means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes; and*

2. *"Company" has the meaning assigned by Section 808.001, except that the term does not include a sole proprietorship.*

3. *Section only applies to a contract that is between a governmental entity and a company with 10 or more full-time employees; and has a value of $100,000 or more that is to be paid wholly or partly from pubic funds of the governmental entity.*

    a. **Does not boycott Israel currently; and**

    b. **Will not boycott Israel during the term of the contract the above-named Company, business or individual with the City of Galveston, Texas.**

Pursuant to Senate Bill 13 of the 87th regular Texas Legislature session:

Verification Regarding Boycotting Energy Companies – Pursuant to Chapter 2274, Texas Government Code, Contractor verifies (1) it does not boycott energy companies, and (2) it will not boycott energy companies during the term of this Agreement. Contractor acknowledges this Agreement may be terminated and payment withheld if this verification is inaccurate. (Note: This provision only applies in a contract that (1) has a value of $100,000 or more that is to be paid wholly or partly from public funds and (2) is with a for-profit entity, not including a sole proprietorship, that has ten (10) or more full-time employees.)

Pursuant to Senate Bill 19 of the 87th regular Texas Legislature session:

Verification Regarding Boycotting Energy Companies – Pursuant to Chapter 2274, Texas Government Code, Contractor verifies (1) it does not boycott energy companies, and (2) it will not boycott energy companies during the term of this Agreement. Contractor acknowledges this Agreement may be terminated and payment withheld if this verification is inaccurate. (Note: This provision only applies in a contract that (1) has a value of $100,000 or more that is to be paid wholly or partly from public funds and (2) is with a for-profit entity, not including a sole proprietorship, that has ten (10) or more full-time employees.)

I, _____ (Person name), the undersigned representative of (Company or

Business Name) _____(hereinafter referred to as Company)

being an adult over the age of eighteen (18) years of age, do hereby depose and verify under oath that the company named-above, under the provisions of Subtitle F, Title 10, Government Code Chapter 2270:

_____ _____

DATE **SIGNATURE OF COMPANY REPRESENTATIVE**

THIS DOCUMENT MUST BE COMPLETED AND SUBMITTED AS IT IS A PART OF THE SOLICITATION PACKAGE AS MENTIONED IN SECTION 6B OF THE RFQ.

Appendix D – Property Tax Statement

FAILURE TO COMPLETE THIS ATTACHMENT SHALL RESULT IN THE PURCHASING SUPERVISOR DEEMING YOUR BID OR PROPOSAL "NON-RESPONSIVE."

The City of Galveston, Texas has adopted the following policy:

The City of Galveston will not do business with any person or business that owes delinquent property taxes to the City.

Please indicate whether you or your company, owe delinquent property taxes to the City whether an assumed name, partnership, corporation, or any other legal form.

_____ I do not owe the City property taxes that are delinquent.

_____ I owe City property taxes that are delinquent on property located at

_____

_____

_____
Proposer's Printed or Typed Name

_____
Proposer's Signature

_____
Date

THIS DOCUMENT MUST BE COMPLETED, SIGNED, AND SUBMITTED AS IT IS A PART OF THE SOLICITATION PACKAGE AS MENTIONED IN SECTION 6B OF THE PROPOSAL.

Appendix E – Nepotism Statement

FAILURE TO COMPLETE THIS ATTACHMENT SHALL RESULT IN THE PURCHASING SUPERVISOR DEEMING YOUR BID OR PROPOSAL "NON-RESPONSIVE."

The Bidder or Proposer or any officer, if the Bidder or Proposer is other than an individual, shall state whether Bidder or Proposer has a relationship, either by blood or marriage, with any official or employee of the City of Galveston by completing the following:

If the Proposer or Bidder is an individual:

_____ I am not related by blood or marriage to any official or employee of the City of Galveston

_____ I am related by blood or marriage to the following official(s) or employee(s) of the City of Galveston

Name and title of City Official

Or employee: _____

Relationship: _____

If the Bidder or Proposer is **NOT** an individual:

_____ The officers of the company submitting this bid or proposal are not related by blood or marriage to any official or employee of the City of Galveston.

_____ The officers of the company submitting this Proposal are related by blood or marriage to the following official(s) or employee(s) of the City of Galveston.

Name and title of officer: _____

Employee and title of City Official or Employee: _____

Relationship: _____

THIS DOCUMENT MUST BE COMPLETED AND SUBMITTED AS IT IS A PART OF THE SOLICITATION PACKAGE AS MENTIONED IN SECTION 6B OF THE PROPOSAL.

Appendix F – Non-Collusion Statement

THE UNDERSIGNED AFFIRM THAT THEY ARE DULY AUTHORIZED TO EXECUTE THIS CONTRACT, THAT THIS COMPANY, FIRM, PARTNERSHIP OR INDIVIDUAL HAS NOT PREPARED THIS PROPOSAL IN COLLUSION WITH ANY OTHER PROPOSER, AND THAT THE CONTENTS OF THIS PROPOSAL AS TO PRICES, TERMS OR CONDITIONS OF SAID PROPOSAL HAVE NOT BEEN COMMUNICATED BY THE UNDERSIGNED NOR BY ANY EMPLOYEE OR AGENT TO ANY OTHER PERSON ENGAGED IN THIS TYPE OF BUSINESS PRIOR TO THE OFFICIAL OPENING OF THIS PROPOSAL.

VENDOR_____

ADDRESS_____

PHONE _____

FAX _____

PROPOSER (SIGNATURE) _____

PROPOSER (PRINTED NAME) _____

POSITION WITH COMPANY _____

SIGNATURE OF COMPANY OFFICIAL
AUTHORIZING THIS PROPOSAL
_____

COMPANY OFFICIAL
(PRINTED NAME) _____

OFFICIAL POSITION _____

THIS DOCUMENT MUST BE COMPLETED, SIGNED, AND SUBMITTED AS IT IS A PART OF THE SOLICITATION PACKAGE AS MENTIONED IN SECTION 6B OF THE PROPOSAL.

Appendix G – Document 00435

THE CITY OF GALVESTON, TEXAS
DOCUMENT 00435, REQUIRED BY ALL PROPOSERS WHO WILL RECEIVE FEDERAL FUNDS IN PAYMENT OF PROCUREMENT.

PROPOSER'S CERTIFICATION REGARDING DEB.ARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION (49 CFR PART 29)

The undersigned certifies, by submission of this proposal or acceptance of this contract, that neither Contractor nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntary excluded from participation in this transaction by any Federal department or agency. Proposer agrees that by submitting this proposal that Proposer will include this clause without modification in all lower tier transactions, solicitations, proposals, contracts, and subcontracts. Where the Proposer or any lower tier participant is unable to certify to this statement, that participant shall attach an explanation to this document.

Certification-the above information is true and complete to the best of my knowledge and belief.

_____
(Printed or typed Name of Signatory)

_____
(Signature)

_____
(Date)

NOTE: The penalty for making false statements in offers is prescribed in **18 U.S.C. 1001**

END OF DOCUMENT 00435-FAA

THIS DOCUMENT MUST BE COMPLETED, SIGNED, AND SUBMITTED AS IT IS A PART OF THE SOLICITATION PACKAGE AS MENTIONED IN SECTION 6B OF THE PROPOSAL.

Appendix H – No Intent to Submit Form

If your firm has chosen <u>not</u> to submit a Proposal for this procurement, please complete this form and submit to:

City of Galveston
Purchasing Division
PO Box 779
Galveston, Texas 77553

City of Galveston
Purchasing Division
823 Rosenberg St. Room 300
Galveston, Texas 77550

Please check all items that apply:

- ☐ Do not sell the item(s) required
- ☐ Cannot be competitive
- ☐ Cannot meet specifications highlighted in the attached request
- ☐ Job too large
- ☐ Do not wish to do business with the City of Galveston
- ☐ Cannot submit electronically
- ☐ Cannot provide Insurance required
- ☐ Cannot provide Bonding required
- ☐ Cannot comply with Indemnification requirement
- ☐ Job too small
- ☐ Other: _____

COMPANY NAME (Please print)**:** _____

Authorized Officer Name (Please print): _____

Telephon**e: (**____**)** _____ Fax: **(**_____**)** _____

You may also email this form to: purchasing@galvestontx.gov.

Appendix I – ACH Form

The City of Galveston would like to thank you for the services you and your company have provided for us in the past, present, and in the future. For those services provided you have more than likely received payments via a paper check in the mail. As we all know, that process is slow, inefficient, and costly for us and for you as the recipient.

Mail can be delayed, lost, or even stolen causing payments to be late and we may then face penalties and late fees. The City of Galveston would like to streamline our payment process with electronic payments. These payments will be transferred electronically from our financial institute to your financial institute. The process will get your payments to you in a quicker, more reliable, and more efficient manner.

If you would like to sign up to start receiving all of your payments via ACH / Wire Transfers, please fill out the authorization forms and return to the City of Galveston Finance Department.

Please email to:

accountspayable@galvestontx.gov

Or mail to:

City of Galveston
Finance Department
P.O. Box 779
Galveston, TX 77553

If you have any questions or concerns, please do not hesitate to call Accounts Payable at 409.797.3569. Please put the Purchase Order Number on your invoices to ensure prompt payment. Again, we appreciate you and the services your business provides for the City of Galveston.

Sincerely,

Michael W. Loftin
Assistant City Manager – Finance

ACH Payment Agreement Form

Authorization Agreement

I hereby authorize the City of Galveston to initiate ACH deposits to my account at the financial institution named below.
Further, I agree not to hold the City of Galveston responsible for any delay or loss of funds due to incorrect or incomplete information supplied by me or by my financial institution, or due to an error on the part of my financial institution in depositing funds to my account.
This agreement will remain in effect until the City of Galveston receives a written notice of cancellation from me or my financial institution, or until I submit a new ACH Payment Agreement Form to the City of Galveston Finance Department.

Account Information

Name of Financial Institution: _____

Financial Institute Address: _____

Routing Number: _____

Account Number: _____

SWIFT Code: (if applicable) _____

Executed agreement must include a confirmation of the banking information from an Authorized Bank Official on bank letterhead with the Authorized Bank Official's business card.

Signature

Company Name: _____

Authorized Signature: _____

Printed Name: _____ Title: _____

Contact Phone Number: _____ Date: _____

FOR CITY USE ONLY:

Verified by: _____ Date Verified: _____

RETURN THIS FORM ONLY UPON AWARD.

Appendix J – Scope of Services

1. Project Title: Pirates Beach Wastewater Treatment Plant Replacement.

2. Scope of Services Contact

Questions about the technical nature of the Scope of Services will be directed to the **Purchasing Division**, Phone. 409.797.3579, e-mail: UPLOAD QUESTIONS HERE

3. Special Conditions

Proposal submittals must be uploaded to the City's online electronic submission portal here: UPLOAD SUBMITTAL HERE.

The maximum file size for upload is 250 mb.

There are required Federal Clauses that shall be returned with the proposal and are part of the contract documents herein.

Project duration to final project completion: 600 calendar days

Project budget: $8,500,000

A bid bond of 5% of the total amount proposed is required for this project. Performance and Payment Bonds are required at the time the contract is executed by the awarded vendor.

Electronic submittals must include the information below, in the order listed with tab pages at the beginning of each section. If additional information provided is not in a category listed below, include a miscellaneous section with a tab page entitled "Miscellaneous". Failure to follow the instructions above may result in the disqualification of the submittal. Proposals must be submitted in the following order:

A. Pricing
B. Bid Bond
C. Required Documents – Appendix A, Appendix B, Appendix C, Appendix D, Appendix E, Appendix F, Appendix G, and Acknowledgement of Addenda
D. References
E. Timeline/Project Schedule
F. Statement of Bidders' Qualifications
G. Financial Statements

Failure to follow the above order may result in the disqualification of the submittal.

4. Proposal Evaluation Factors

Emphasis	Factor
35%	Cost
25%	Past Performance on similar projects of size and scope
25%	Overall Experience of Project Manager & Site Superintendent
15%	Proposed Schedule

5. Brand Manufacture Reference

The City has determined that any manufacturer's brand defined in the Scope of Services meets the City's product and support need. The manufacturer's reference is not intended to be restrictive, and is only descriptive of the type and quality the City desires to purchase. Quotes for similar manufactured products of like quality will be considered if the Proposal is fully noted with the manufacturer's brand name and model. The City reserves the right to determine products and support of equal value, and whether other brands or models meet the City's product and support needs.

6. Key Events Schedule

Proposal Release Date	October 13, 2021
Pre-Proposal Conference Date	October 26, 2021 @ 10:00am
Deadline for Submittal of Written Questions	November 15, 2021 @ 2:00pm
Sealed Proposals Due to and Opened by City	December 15, 2021 @ 10:00am
Anticipated Committee Evaluation Review Date	January, 2022
Anticipated Award Date	February, 2022

7. Scope of Services ***(ATTACH SCOPE OF SERVICE DETAILS HERE) ***

APPENDIX K – FEDERAL CLAUSES

The following, federally mandated, clauses require acknowledgement of the offeror and are considered part of the contract between the City of Galveston and the awarded vendor. Any offeror that does not acknowledge the clauses below shall be considered non-responsive and will not be considered for award.

1. **NO GOVERMENTAL OBLIGATION TO THIRD PARTIES:** The Owner and Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the Federal Government, the Federal Government is not a party to this contract and shall not be subject to any obligations or liabilities to the Owner, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying contract.

2. **PROGRAM FRAUD AND FALSE OR FRAUDULENT STATEMENTS AND RELATED ACTS:** Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. § 3801 et seq., "Administrative Remedies for False Claims and Statements," apply to its actions pertaining to this Project. Upon execution of the underlying contract, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to the underlying contract for which this contract work is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent the Federal Government deems appropriate.

3. **ACCESS TO RECORDS AND REPORTS:** The contractor agrees to provide (insert name of state agency or local or Indian tribal government), (insert name of recipient), the FEMA Administrator, the Comptroller General of the United States, or any of their authorized representatives access to any books, documents, papers, and records of the Contractor which are directly pertinent to this contract for the purposes of making audits, examinations, excerpts, and transcriptions. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed. The contractor agrees to provide the FEMA Administrator or his authorized representatives access to construction or other work sites pertaining to the work being completed under the contract."

4. **EQUAL EMPLOYMENT OPPORTUNITY:** The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other

contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions as may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law. The vendor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, That in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency the contractor may request the United States to enter into such litigation to protect the interests of the United States."

5. **GOVERNMENT-WIDE SUSPENSION AND DEBARMENT:** This contract is a covered transaction for purposes of 2 C.F.R. pt. 180 and 2 C.F.R. pt. 3000. As such the contractor is required to verify that none of the contractor, its principals (defined at 2 C.F.R. § 180.995), or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935). The contractor must comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into. This certification is a material representation of fact relied upon by (insert name of subrecipient). If it is later determined that the contractor did not comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt.3000, subpart C, in addition to remedies available to (name of state agency serving as recipient and name of subrecipient), the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to comply with the requirements of 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

6. **CONTRACT WORK HOURS AND SAFETY STANDARDS ACT:**
   1. **Overtime requirements** - No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. **Violation; liability for unpaid wages; liquidated damages -** In the event of any violation of the clause set forth in paragraph (1) of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this section.
3. **Withholding for unpaid wages and liquidated damages** – The Owner shall, upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this section.
4. **Subcontracts** - Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs (1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1) through (4) of this section.

7. **LOBBYING:**

Byrd Anti-Lobbying Amendment, 31 U.S.C. § 1352 (as amended)

Contractors who apply or bid for an award of $100,000 or more shall file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient.

APPENDIX A, 44 C.F.R. PART 18 – CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements
(To be submitted with each bid or offer exceeding $100,000)

The undersigned [Contractor] certifies, to the best of his or her knowledge, that:

1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a

Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, U.S.C. § (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

The Contractor certifies or affirms by signing this contract the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, Contractor understands and agrees that the provisions of 31 U.S.C. § 3801 *et seq* apply to this certification and disclosure, if any.

8. CLEAN AIR 42 U.S.C. § 7401 et seq.: Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 et seq. The Contractor agrees to report each violation to the Owner and understands and agrees that the Owner will, in turn, report each violation as required to assure notification to the State of Texas, Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.

Contractor also agrees to include these requirements in each subcontract exceeding $150,000 financed in whole or in part with Federal assistance provided by FEMA.

9. CLEAN WATER REQUIREMENTS 33 U.S.C. 1251 et seq.: Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 *et seq*. Contractor agrees to report each violation to the Owner and understands and agrees that the Owner will, in turn, report each violation as required to assure notification to the State of Texas, Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office. Contractor also agrees to include these requirements in each subcontract exceeding $150,000 financed in whole or in part with Federal assistance provided by FEMA.

10. PROCUREMENT OF RECOVERED MATERIALS 42 U.S.C 6962:

(1) In the performance of this contract, the Contractor shall make maximum use of products containing recovered materials that are EPA- designated items unless the product cannot be acquired—

(i) Competitively within a timeframe providing for compliance with the contract performance schedule;

(ii) Meeting contract performance requirements; or

(iii) At a reasonable price.

(2) Information about this requirement, along with the list of EPA-designate items, is available at EPA's Comprehensive Procurement Guidelines web site, https://www.epa.gov/smm/comprehensive- procurement-guideline-cpg-program.

11. **DEPARTMENT OF HOMELAND SECURITY SEAL, LOGO, AND FLAGS:** By signing this contract, the contractor agrees it shall not use the DHS seal(s), logos, crests, or reproductions of flags or likenesses of DHS agency officials without specific FEMA pre- approval.
12. **COMPLIANCE WITH FEDERAL LAW, REGULATIONS, AND EXECUTIVE ORDERS:** This is an acknowledgement that FEMA financial assistance will be used to fund the contract only. The contractor will comply will all applicable federal law, regulations, executive orders, FEMA policies, procedures, and directives.

13. **COMPLIANCE WITH DAVIS-BACON ACT AND COPELAND "ANTI-KICKBACK" ACT:**
Minimum wages - (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR Part 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:
(1) Except with respect to helpers as defined as 29 CFR 5.2(n)(4), the work to be performed by the classification requested is not performed by a classification in the wage

determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination; and

(4) With respect to helpers as defined in 29 CFR 5.2(n)(4), such a classification prevails in the area in which the work is performed.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(v)(A) The contracting officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefor only when

the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination with 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(v) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(2) Withholding - The [*City of Galveston*] shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, the [*City of Galveston*] may, after written notice to the contractor, sponsor,

applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records - (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the [*City of Galveston*] for transmission to the Federal Transit Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under section 5.5(a)(3)(i) of Regulations, 29 CFR part 5. This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal Stock Number 029-005-00014-1), U.S. Government Printing Office, Washington, DC 20402. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be maintained under section 5.5(a)(3)(i) of Regulations, 29 CFR part 5 and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set

forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the Federal Transit Administration or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees – (i) Apprentices – Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program

for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator of the Wage and Hour Division of the U.S. Department of Labor determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees – Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity – The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements – The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts – The contractor or subcontractor shall insert in any subcontracts the

clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the Federal Transit Administration may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination: debarment – A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements – All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards – Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility – (i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

I, _____ (printed name), the undersigned, do hereby acknowledge, and agree to comply, with the above statements for the entire length of any agreement with the City of Galveston, Texas.

_____ _____

Signature of Authorized Company Representative Date

THIS DOCUMENT MUST BE SIGNED AND SUBMITTED AS IT IS A PART OF THE PROPOSAL PACKAGE AS MENTIONED IN SECTION 6B OF THE SOLICITATION.

BID PROPOSAL

Proposal amount for Base Bid shall be shown in both words and figures. In the event of a discrepancy, the amount shown in words shall govern. In the event of a discrepancy between the unit price and total line extended, the unit price shall govern.

City of Galveston Pirates Beach Wastewater Treatment Plant (WWTP) Replacement Project – BASE BID:

Item No.	Description of Work	Unit	QTY	Unit Price	Total Amount Bid
BB-1	**Mobilization**, **Temporary Facilities and Controls**, complete in place, in full accordance with the Technical Specifications and the Construction Drawings.	LS	1	$	$
BB-2	**Project Sign**, complete in place and with all associated appurtenances, in full accordance with the Technical Specifications and the Construction Drawings.	EA	1	$	$
BB-3	**Trench Safety including Trench Safety Plan and all necessary shoring**, complete in place and in full accordance with the Technical Specifications.	LF	500	$	$
BB-4	**6-inch Concrete Access Road and Driveway Pavement**, complete in place, in full accordance with the Technical Specifications and the Construction Drawings.	SY	600	$	$
BB-5	**Headworks, Biological Treatment Unit, Effluent Filters, UV Disinfection, Odor Control, Package Lift Station including structures, equipment, pumps, piping, supports, valves, meters, elevated and platforms,** complete in place and with all associated appurtenances, in full accordance with the Technical Specifications and the Construction Drawings.	LS	1	$	$
BB-6	**All Electrical, Controls, Instrumentation, MCCs and Emergency Generator**, complete in place and with all associated appurtenances, in full accordance with the Technical Specifications and the Construction Drawings.	LS	1	$	$
BB-7	**One Wemco Grit King Grit Units and a Grit Washer, or pre-approved equivalent*,** for the hydraulically induced vortex grit removal system to be provided by Grit King and the grit washer, complete as specified.	LS	1	$	$
BB-8	**One Enaqua Ultraviolet (UV) System, or pre-approved equivalent*,** for the non-contact UV disinfection system, complete as specified.	LS	1	$	$
BB-9	**Two Kaeser Blowers, or pre-approved equivalent*,** for the rotary screw blowers, complete as specified.	LS	1	$	$
BB-10	**Miscellaneous Site Work including clearing, grubbing, hydromulch seeding, final grading, landscaping, 4-inch concrete scour protection, 6-inch gravel road, SWPPP, SWPPP implementation and fencing,** complete in place, in full accordance with the Technical Specifications and the Construction Drawings	LS	1	$	$

* NOTE:

1. Items noted on the Proposal form as "or pre-approved equivalent" must receive City approval prior to being acceptable.
2. Equivalent products must be submitted by the question deadline established in Appendix J. Section 6 - Key Events Schedule.
3. Any acceptance or rejection of the equivalent product or process will be included in the final addenda.
4. The process for proposing an equivalent product is described in Section 01630 Product Options and Substitutions **except** for the timing in para. 1.06.C. Submission for pre-approval of an equivalent product or process must be by the question deadline established in Appendix J. Section 6 - Key Events Schedule.

Item No.	Description of Work	Unit	QTY	Unit Price	Total Amount Bid
BB-11	**All other components associated with Pirates Beach WWTP Replacement construction**, complete in place and with all associated appurtenances, in full accordance with the Technical Specifications and as shown on the Construction Drawings.	LS	1	$	$
BB-12	**Additional Structural Concrete**, complete in place, in full accordance with the Technical Specifications and to the limits authorized in writing by Owner. ***Note: This is a contingent item and shall be executed only if authorized in writing by Owner.**	CY	100	$	$
BB-13	**Additional Select Fill**, complete in place, in full accordance with the Technical Specifications and to the limits authorized in writing by Owner. ***Note: This is a contingent item and shall be executed only if authorized in writing by Owner.**	CY	100	$	$
BB-14	**Additional 6-inch Concrete Pavement**, complete in place, in full accordance with the Technical Specifications and to the limits authorized in writing by Owner. ***Note: This is a contingent item and shall be executed only if authorized in writing by Owner.**	SY	100	$	$
BB-15	**Bypass pumping**, including all equipment, materials, and fuel, complete in place, in full accordance with the Technical Specifications and as directed by the Owner. ***Note: This is a contingent item and shall be executed only if authorized in writing by Owner.**	WK	10	$	$

TOTAL AMOUNT for Pirates Beach WWTP Replacement Project – BASE BID (Items BB-1 through BB-15):

_____ **(Use Words)**

$ _____ **(Use Figures)**

**Total amount specified for BASE BID shall include all costs, commissions, overhead, permits, and payments required and necessary to facilitate Contractor's completion of the work as specified.*

Pirates Beach WWTP Replacement Project – BID ALTERNATES:

Item No.	Description of Work	Unit	QTY	Unit Price	Total Amount Bid
BA-1	**Add or deduct to replace all below water aeration basin PVC piping with 316L stainless steel piping**, complete in place. ***Note: This is a contingent item and shall be executed only if authorized in writing by Owner.**	LS	1	$	$
BA-2	**Decommission the existing Pirates Beach WWTP**, complete in place. ***Note: This is a contingent item and shall be executed only if authorized in writing by Owner.**	LS	1	$	$
BA-3	**Remove and properly dispose of wastewater sludge and associated materials** from the Pirates Beach WWTP per TCEQ regulations, complete in place. ***Note: This is a contingent item and shall be executed only if authorized in writing by Owner.**	Tons	400	$	$

Item No.	Description of Work	Unit	QTY	Unit Price	Total Amount Bid
BA-4	**Demolish and dispose of the existing Pirates Beach WWTP facilities**, including all tankage, piping, structures, the blower building and miscellaneous appearances, complete in place. ***Note: This is a contingent item and shall be executed only if authorized in writing by Owner.**	LS	1	$	$

City of Galveston Pirates Beach WWTP Replacement Project – BID SUMMARY:

BS-1	TOTAL AMOUNT for BASE BID (Items BB-1 through BB-15)	$	(A)
BS-2	TOTAL AMOUNT for BID ALTERNATES (Items BA-1 through BA-4)	$	(B)
BS-3	Subtotal of Accepted Alternate Bid Items (To be completed by OWNER)	$	(C)
BS-4	Total Amount Bid for the Project (To be completed by OWNER)	$	(A+C)

City of Galveston Pirates Beach WWTP Replacement Project – BID CERTIFICATION:

_____

Company

_____

Name and Title of Authorized Representative

_____

Signature **Date**

Additional Information Request from Prospective Bidders

Questions related to status of your firm:

1. Identify if your firm is currently for sale or involved in any transaction to expand or to become acquired by another business entity? If so, please explain the impact both in organization and company direction.

2. Provide details of any past or pending litigation, or claims filed, against your firm that may affect your performance under a Contract with the Owner.

3. Identify if your firm is currently in default on any loan agreement or financing agreement with any bank, financial institution, or other entity? If so, specify date(s), details, circumstances, and prospects for resolution.

4. Does any relationship exist by relative, business associate, capital funding agreement, or any other such kinship between your firm and any Owner employee? If so, please explain.

Questions related to qualifications of project team:

1. Provide resumes of your team that will be directly involved in the Project, including their experience with similar projects, the number of years with the firm, and their city(s) of residence. Explain their experience in reviewing plans, specifications and submittals to ensure compliance with the contract. Include as applicable; Project Managers, Superintendents, Assistant Project Managers and Superintendents, Expeditors, Project Scheduler, Estimators, Quality Control Inspectors, Safety Coordinator / Assistant, Carpenter Forman, and Labor Forman.

2. For each team member identified above, provide his/her current status, and when each team member will be available to perform or manage the construction of this Project.

3. Describe, in graphic and written form, the proposed Project assignments and lines of authority and communication for each team member to be directly involved in the Project. Indicate the estimated percent of time these team members will be involved in construction.

4. Identify the ***CIVIL, MECHANICAL, ELECTRICAL AND PLUMBING*** staff and Subcontractors included as part of this proposal, including their experience with similar projects, the number of years with the firm, and their city(s) of residence.

5. Provide resumes of the Project Manager and Superintendent that will be directly involved in the Project for the ***CIVIL, MECHANICAL, ELECTRICAL AND PLUMBING*** work, including their experience with similar projects, the number of years with the firm, and their city(s) of residence.

Questions related to project type and references:

List the projects in order of priority, with the most relevant project listed first. Provide the following information for each project listed:

- Project name, location, contract delivery method, and description
- Media (photos/videos)
- Initial and Final construction cost
- Planned vs actual completion date
- Actual Notice To Proceed, Substantial Completion, and Final Payment dates
- Name of Project Manager (individual responsible to the Owner for the overall success of the project)
- Name of Project Superintendent (individual responsible for coordinating the day to day work)
- Names of Civil, Mechanical, Plumbing and Electrical Subcontractors

References (for each project listed above, identify the following):

- The Owner's representative who served as the day-to-day liaison during construction, including telephone number
- Architect/Engineer's name and representative who served as the day-to-day liaison during construction, including telephone number

References shall be considered relevant based on specific project participation and experience with the respondent. The Owner may contact references during any part of this process. The Owner reserves the right to contact any other references at any time during the RFP process.

Question related to awards received for exemplary construction work:

Identify a maximum of three (3) completed projects, of any type, for which your firm has received an award for construction excellence from a recognized organization and provide descriptive information for each.

Information to illustrate schedule planning and compliance:

1. Provide a Microsoft Project Milestone schedule for this Project using the Project Planning Schedule and identify specific critical process, phases, milestones, approvals, and procurements anticipated. Clearly identify the 10% Total Project Float required during the Construction Phase.

2. Describe what you perceive are the critical Construction issues for this Project?

3. Describe your approach to assuring timely completion of this project, including methods for schedule recovery, if necessary.

Information on your quality control application to this project:

1. Describe your quality control program. Explain the methods used to ensure quality control during the Construction phase of a project.

2. Describe how your quality control team will measure the quality of construction and commissioning performed by trade Subcontractors on this Project, and how will you address non-conforming work.

Site control, daily documentation and performance measures:

1. Describe how you maintain maintained security on this Project.

2. Describe your past experience dealing with congested site conditions for any project listed in this RFP.

3. Provide examples of records, reports, monitoring systems, and information management systems you will use on this Project.

4. Describe your approach to coordinating inspections and approvals

5. Describe your Best Management Practices for containing storm water run-off as required by the Environmental Protection Agency's National Pollutant Discharge Elimination System and The City of Galveston.

6. Describe your job site safety program for this Project and specific safety policies in which employees must be in compliance.

7. Identify any deaths that have occurred on a project site controlled by your firm, or any subcontractor(s) (at any contractual level), that had a death on your project site? If so, describe how you have revised your program.

8. Describe how you will measure the quality of service provided to the Owner for this Project.

Information related to your redlines, payments, and warranty service track record:

1. How often do you redline to update construction plans which document field implementation?

2. Describe your warranty service support philosophy and warranty service implementation plan for this Project.

3. For item 2, given the nature of the project, were there an unusually high number of claims or unusual difficulty in resolving them?

4. Did you make timely payments to either subcontractors or suppliers?

STATEMENT OF BIDDER'S QUALIFICATIONS

All questions must be answered and the data given must be clear and comprehensive. **This statement must be notarized.** If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information it desires.

Date: _____
Bidder (Legal Name of Firm):_____
Date Organized:_____
Name of Owner(s):_____
Address :_____

_____:_____
Date Incorporated_____
Federal ID Number: _____
Number of Years in contracting business under present name_____
List all other names under which your business has operated in the last 10 years:

Work Presently Under Contract:

Contract	Amount $	Completion Date

Type of work performed by your company: _____

Total Staff employed by Firm (Break down by Managers and Trades on separate sheet):

_____
_____
_____

Have you ever failed to complete any work awarded to you? Yes No
(If yes, please attach summary of details on a separate sheet. Include brief explanation of cause and resolution)

Have you ever defaulted on a contract? Yes No
(If yes, please attach summary of details on a separate sheet.)

Has your organization had any disbarments or suspensions that have been imposed in the past five years or that was still in effect during the five year period or is still in effect? Yes No

(If yes, list and explain; such list must include disbarments and suspensions of officers, principals, partners, members, and employees of your organization.)

List the projects most recently completed by your firm (include project of similar importance):

Project	Amount $	Mo/Yr Completed

Major equipment available for **this** contract: _____
_____
_____

Are you in compliance with all applicable EEO requirements? Yes No
(If no, please attach summary of details on a separate sheet.))

Are you a Section 3 business? (see below) □ Yes □ No
Section 3 Business Concerns:
a) Businesses that are 51 percent or more owned by Section 3 residents;

b) Businesses whose permanent, full-time employees include persons, at least 30 percent of whom are currently Section 3 residents, or within three years of the date of first employment with the firm were Section 3 residents;
c) Businesses that provide evidence of a commitment to subcontract in excess of 25 percent of the dollar amount of all subcontracts to be awarded to businesses that meet the qualifications described above; or
d) Businesses located within the Grant Recipient's jurisdiction that identifies themselves as Section 3 Business Concerns because they provide economic opportunities for low- and very low income persons.

Bank References
Address: _____ Contact Name: _____
City & State: _____Zip: _____Phone Number: _____
Credit available: $ _____

Has the firm or predecessor firm been involved in a bankruptcy or reorganization? Yes No
(If yes, please attach summary of details on a separate sheet.)

List on a sheet attached hereto all judgements, claims, arbitration proceedings, or suits pending or outstanding against bidder over the last five (5) years with amount of claim and brief description.

List on a sheet attached hereto all lawsuits or requested arbitration with regard to construction contracts which bidder has initiated within the last five (5) years and brief explanation of claim and outcome.

Attach resume(s) for the principal member(s) of your organization, including the officers as well as the proposed superintendent for the project.

Signed this_____day of _____, 20____.

_____
Signature

_____
Printed Name and Title

_____
Company Name

Notary Statement:
_____. being duly sworn, says that he/she is the _____Position/Title _____of_____ (Firm Name), and hereby swears that the answers to the foregoing questions and all statements therein contained are true and correct. He/she hereby authorizes and requests any person, firm, or corporation to furnish any information requested City/County of _____ in verification of the recitals comprising this Statement of Bidder's Qualifications.

Subscribed and sworn before me this _____day of _____, 20____.

Notary Public

_____
Signature

_____
Printed Name
My Commission Expires: _____,
The penalty for making false statements is prescribed in the U. S. Criminal Code, 18 U.S.C. 1001.

BID BOND

THE STATE OF TEXAS

SURETY'S NO._____

KNOWN ALL MEN BY THESE PRESENT, THAT _____

_____of the City of

_____, County of _____, and State of _____

as Principal, and _____, as Surety,

Are held and firmly bound unto the City of Galveston, Texas, a home rule municipal corporation of Galveston County, Texas, as Obligee, in the amount of:

_____

_____(written amount); ($_____),

DOLLARS for payment whereof the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid to enter into a certain written contract with the Obligee for:

PIRATES BEACH WASTE WATER TREATEMENT PLANT REPLACEMENT

NOW, THEREFORE, the condition of the obligation is such that if the Principal shall faithfully enter into such written contract, then this bid bond shall be void; otherwise this bid bond shall remain in full force and effect.

IT IS EXPRESSLY UNDERSTOOD AND AGREED that if the Principal withdraws its Bid any time after such Bid is opened and before official rejection of such Bid by Obligee or, if the Principal is successful in securing the award of the contract, and fails to enter into the Contract or furnish satisfactory Performance and Payment Bonds (if required), the Obligee, in either of such events, shall be entitled and is hereby given the right to collect the full amount of this Bid Bond as liquidated damages.

PROVIDED, further that if any legal action is filed upon this Bond, venue shall lie in Galveston County, State of Texas.

IN WITNESS THEREOF, the Principal and Surety does sign and seal this instrument.

This_____day of _____2021.

_____	_____
Principal	**Surety**
By_____	**By_____**
Address _____	**Address _____**
_____	_____

APPROVED AS TO FORM:

_____
Office of the City Attorney

NOTE: Attach Power of Attorney

"General Decision Number: TX20210062 05/07/2021

Superseded General Decision Number: TX20200062

State: Texas

Construction Type: Heavy

County: Galveston County in Texas.

HEAVY CONSTRUCTION PROJECTS Including Water and Sewer Lines (Does Not Include Flood Control)

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

federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the
Davis-Bacon Related Acts, including those set forth at 29 CFR
5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available
at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/01/2021
1	03/12/2021
2	05/07/2021

* SFTX0669-001 04/01/2021

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers)	$ 31.68	22.20

SUTX2005-021 08/05/2005

HEAVY Including Water and Sewer Lines (Excluding Flood Control)

	Rates	Fringes
Carpenter	$ 14.38	
Cement mason/concrete finisher	$ 11.37	1.13
Electrician	$ 18.40	1.34
FORM BUILDER/FORM SETTER	$ 13.35	1.17
IRONWORKER, REINFORCING	$ 11.29	
Laborers:		
Common	$ 10.70	

Landscape	$ 7.35	
Mason Tender Cement	$ 9.96	
Pipelayer	$ 10.07	
PIPEFITTER	$ 17.00	0.04
Power equipment operators:		
Excavator	$ 16.74	
Backhoe	$ 13.25	
Bulldozer	$ 14.00	
Crane	$ 14.91	0.58
Front End Loader	$ 11.75	0.92
Grader	$ 12.20	1.48
Tractor	$ 12.38	1.51
TRUCK DRIVER	$ 12.28	0.98

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

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other

health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

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

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

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed

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

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

Survey Rate Identifiers

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

these classifications and rates are based. The next number, 007
in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion
date for the classifications and rates under that identifier.

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

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union
average rate. OH indicates the state. The next number, 0010 in
the example, is an internal number used in producing the wage
determination. 08/29/2014 indicates the survey completion date
for the classifications and rates under that identifier.

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

WAGE DETERMINATION APPEALS PROCESS

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

be:

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

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

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

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

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

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

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

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

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

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

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END OF GENERAL DECISION"

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GENERAL CONDITIONS OF THE AGREEMENT

1. **OWNER:** **Whenever the word "Owner" is used in this contract, it shall be understood as referring to the City of Galveston, Texas. The City acts through its City Manager when he has been authorized by City Council, otherwise the City acts through City Council.**

2. **CONTRACTOR:** **Whenever the word "Contractor" is used, it shall be understood to mean the person, persons, co-partnership or corporation, to-wit: _____who has agreed to perform the work embraced in this contract.**

3. **OWNER'S REPRESENTATIVE:** **Whenever the word Owner's Representative or representative is used in this contract, it shall be understood to mean: _____, who offices at:_____ Galveston, Texas, under whose supervision these contract documents, including the plans and specifications, were prepared, and who will inspect construction; or to such other representative, supervisor, or inspector as may be authorized by the Owner to act under this Agreement. Engineers, supervisors or inspectors will act for the Owner under the direction of Owner's Representative, but shall not directly supervise the Contractor or employees acting in behalf of the Contractor.**

4. **CONTRACT DOCUMENTS:** **The contract documents shall consist of the Notice to Bidder, Invitation to Bid, General Instructions to Bidders, Bid Proposal, Signed**

Contract, Statutory Bonds (if required), General Conditions of the Agreement, Special Conditions of the Agreement, Specifications, Plans, Insurance Certificates, Notice of Acceptance, Notice to Proceed, Advertisement for bids, and all other documents made available to Bidder for his inspection in accordance with the Notice to Bidders. The Contract Documents shall be bound together, and every document included in the binding is part of the contract. Additionally, oversized plans and specifications shall be considered part of the Contract Documents even if not so bound.

The Contract Documents are complimentary and what is called for by any one shall be as binding as if called for by all. In case of conflict between any of the Contract Documents, priority of interpretation shall be in the following order unless otherwise provided: Signed Agreement, Performance & Payment Bonds, Special Bonds (if any), Proposal, Special Conditions of Agreement, Notice to Contractors, Technical Specifications, Plans, and General Conditions of Agreement.

5. **INTERPRETATION OF PHRASES: Whenever the words "Directed", "Required", "Permitted", "Designated", "Considered Necessary", "Prescribed", or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation or prescription of the Owner's Representative is intended; and similarly, the words "Approval", "Acceptable", "Satisfactory", or words of like import shall mean approval by or acceptable or satisfactory to the Owner's Representative.**

Whenever in the Specifications or Plans accompanying this Agreement, the terms or description of various qualities, relative finish, workmanship, or other qualities of similar kind which cannot from their nature be specifically and clearly described and specified, are necessarily described in general terms, the fulfillment of which must depend on individual judgment, then, in all such cases, any questions of the fulfillment of said Specifications or Plans shall be decided by the Owner's Representative and said work shall be done in accordance with the Owner's interpretations of the meaning of the words, terms, or clauses defining the character of the work.

6. **SUBCONTRACTOR: The term "Subcontractor", includes only those having a direct contract with the Contractor for performance of work on the project contemplated by these documents. Contractor shall submit the names and addresses of all proposed subcontractors to the Owner. Subcontractors may be disqualified by Owner for the same reason that a Contractor may be disqualified. Owner shall have no responsibility to any Subcontractor employed by Contractor for performance of work on the project contemplated by these contract documents, but Subcontractors will look exclusively to Contractor for any payments due to the Subcontractor.**

7. **WRITTEN NOTICE: Written notice shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or an officer of the corporation for whom it is intended, or if delivered at or sent certified mail to the last business address known to the Party who gives the notice.**

8. **WORK: Unless otherwise stipulated, the Contractor shall provide and pay for all materials, supplies, machinery, equipment, tools, superintendence, labor, insurance, and all water, light, power, fuel, transportation and all other facilities necessary for the execution and completion of the work covered by the contract documents. Unless otherwise specified, all material shall be new and both workmanship and materials shall be of good quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials. Materials or work described in words that so applied have well known, technical or trade meaning shall be held to refer to such recognized standards. All work shall be done and all materials furnished in strict conformity with the contract documents.**

9. **SUBSTANTIALLY COMPLETED: The term "Substantially Completed" means that the structure or project contemplated by the contract documents has been made suitable for use or occupancy, or the facility is in a condition to serve its intended purpose but still may require minor miscellaneous work and adjustment. The Engineer, or his designee, shall certify whether the project is substantially completed.**

10. **LAYOUT OF WORK: Except as specifically provided, the Contractor shall be responsible for laying out all work and shall accomplish this work in a manner acceptable to the Owner's Representative. The Owner's Representative will check the Contractor's layout of all major structures and other layout work done by the Contractor at Contractor's request, but this check does not relieve the Contractor of the responsibility of correctly locating all work in accordance with the Plans and Specifications.**

11. **KEEPING OF PLANS AND SPECIFICATIONS ACCESSIBLE: The Contractor shall be furnished with Five (5) copies, of all Plans, Profiles and Specifications without expense to Contractor and shall keep one copy of the same consistently accessible on the job site.**

12. **RIGHT OF ENTRY: The Owner's Representative may make periodic visits to the site to observe the progress and quality of the executed work and to determine, in general, if the work is proceeding in accordance with the contract documents. The Owner's Representative will not be required to make exhaustive or continuous on-site inspection to check the quality or quantity of the work, nor will the Owner's Representative be responsible for the construction means, methods, techniques, sequences or procedures, or the safety precautions. The Representative's efforts will be directed toward providing assurances for the Owner that the completed project will conform to the requirements of the contract documents, but the Representative will not be responsible for the Contractor's failure to perform the work in accordance with the contract documents. On the basis of on-site observations, the Representative will keep the Owner informed of the progress of the work and will endeavor to guard the Owner against defects and deficiencies in the work of the Contractor.**

13. **LINES & GRADES: The construction plans include a horizontal control line (baseline) and vertical control points (bench marks). These will be established or**

shown to the Contractor prior to commencing construction. After construction has started, the Contractor shall be responsible for protecting and preserving these controls. From these controls the Contractor shall stake all alignments for the work and will be responsible for all horizontal and vertical construction staking.

14. <u>OWNER'S REPRESENTATIVE'S AUTHORITY AND DUTY:</u> Unless otherwise specified, it is mutually agreed between the Parties to this Agreement that the Owner's Representative shall review all work. The Representative has the authority to stop work whenever, in his/her opinion, such stoppage may be necessary to ensure the proper execution of the contract.

In order to prevent delays and disputes and to discourage litigation, it is further agreed that the Owner's Representative shall, in all cases, determine the amounts and quantities of the several kinds of work that are to be paid for under this contract. The Owner's Representative shall also determine all questions in relation to said work and the construction, and shall in all cases decide questions concerning the contract raised by the Contractor in consultation with the project's design professional where the Representative deems such consultation appropriate.

The Owner's Representative shall, within ten (10) business days of the date of the Contractor's question(s)/claim, render and deliver to both the Owner and the Contractor a written decision on all claims and on all questions which may arise relative to the execution of the work or the interpretation of the contract, specifications and plans. This includes determinations with regard to whether a Change Order should issue. Should the Owner's Representative fail to make such decision within the above stated time, the failure shall be considered a denial of Contractor's request.

Should Owner's Representative render any decision or give any direction, which in the opinion of the Contractor, is not in accordance with the meaning and intent of this contract, Contractor may file with Owner (with a copy to the City Manager) written objections to and appeal of the decision or direction within ten (10) business days. The Objection and Appeal to the Owner is a condition precedent to and shall reserve the Party's right to submit the question to mediation and litigation and to any rights of the Contractor to receive any additional money or time under this contract.

However, because it is the intent of this Agreement that there shall be no delay in the execution of the work, decisions or directions of the Owner's Representative, as rendered, shall at all times be promptly carried out, and any claim/objection arising from such decision or direction shall be submitted to the Owner prior to mediation which is a condition precedent to any litigation that may be initiated.

No person, including the Owner's Representative, has authority to increase the cost of this project to more than the amount authorized by City Council without obtaining a Change Order from City Council.

15. **SUPERINTENDENCE AND INSPECTION:** **The Contractor agrees that the Owner's Representative shall be and is authorized to appoint from time to time such subordinate engineers, supervisors, or inspectors as the Owner's Representative deems proper to determine if the materials furnished and the work done under this Agreement is done in accordance with the Specifications.**

The Contractor shall furnish all reasonable aid and assistance required by the subordinate engineers, supervisors, or inspectors for the proper observation and examination of the work. The Contractor shall regard and obey the written instructions of any subordinate engineer, supervisor, or inspectors so appointed. However, should the Contractor object to any written instruction by any subordinate engineer, supervisor or inspector, the Contractor may, within ten (10) business days of the instruction, make written appeal to the Owner's Representative in the manner set out above. However, no observation by the Owner's Representative shall affect Contractor's responsibility for proper construction in accordance with the plans and specifications furnished by Owner nor shall it affect Contractor's liability for failure to do so.

16. **CONTRACTOR'S DUTY AND SUPERINTENDENCE:** **The Contractor shall give personal attention to the faithful prosecution and completion of this contract. The Contractor shall have on the jobsite a competent superintendent and any necessary assistants having good communication skills, all satisfactory to Owner's Representative. The superintendent shall represent the Contractor in the Contractor's absence and all directions given to the superintendent shall be binding as if given to the Contractor. Adequate supervision by competent and reasonable representatives of the Contractor is essential to the proper performance of the work; lack of such supervision shall be grounds for suspending operations of the Contractor.**

The work, from its commencement to completion, shall be under the exclusive charge and control of the Contractor and all risk shall be borne by the Contractor.

The Owner or Owner's Representatives shall not be responsible for the acts or omissions of the Contractor, or any subcontractors, or any of the Contractor's agents or employees, or any other persons performing any of the work.

17. **CONTRACTOR'S UNDERSTANDING:** **It is understood and agreed that the Contractor, after careful examination, is satisfied as to the nature and location of the work, the confirmation of the ground, the character, quality and quantity of materials to be encountered, the character of equipment and facilities needed before and during the work, and the general and local conditions, and all other matters which in any way affect the work under this contract.**

No verbal agreement or conversation with any officer, agent, representative or employee of the Owner, either before or after the execution of this contract, shall effect or modify any of the terms or obligations herein contained.

18. **AGREEMENT OF WORKERS:** **The Contractor agrees to employ only orderly and competent workers, skillful in the performance in the type of work required under this contract. Contractor agrees that whenever the Owner's Representative shall inform the Contractor in writing that any workers are incompetent, unfaithful, or disorderly, such worker or workers shall be discharged from the work and shall not again be employed on the work without the Owner's Representative's written consent.**

19. **CONSTRUCTION PLANT:** **The Contractor shall provide all labor, tools, equipment, machinery and materials necessary in the prosecution and completion of this contract where it is not otherwise specifically provided that Owner shall furnish same, and it is also understood that Owner shall not be held responsible for the care, preservation, conservation, or protection of any materials, tools, equipment or machinery or any part of work until the work is finally completed and accepted.**

The building of structures for the housing of workers or equipment will be permitted only at such places as the Owner's Representative shall designate, and the sanitary conditions of the grounds in or about such structure shall at all times be maintained in a manner satisfactory to the Owner's Representative.

20. **SANITATION:** **Necessary sanitary conveniences for the use of laborers on the work site, properly screened from public observation, shall be provided, constructed and maintained by the Contractor in such manner and at such points as shall be approved by the Owner's Representative. Contractor shall strictly enforce use of sanitary conveniences.**

21. **OBSERVATION AND TESTING:** **The Owner or Owner's Representative shall have the right at all reasonable times to observe and test the work. Contractor shall make necessary arrangements and provide proper facilities and access for such observation and testing at any location wherever work is in preparation or progress. Contractor shall ascertain the scope of any observation which may be contemplated by Owner or Owner's Representative and shall give ample notice as to the time each part of the work will be ready for such observation. Owner or Owner's Representative may reject any work found to be defective or not in accordance with the contract documents, regardless of the stage of its completion or the time or place of discovery of such errors, and regardless of whether Owner's Representative has previously accepted the work through oversight or otherwise. In the event that any part of the work is being fabricated or manufactured at a location where it is not convenient for Owner or Owner's Representative to make observations of such work or require testing of said work, then in such event Owner or Owner's Representative may require Contractor to furnish Owner or Owner's Representative certificates of inspection, testing or approval made by persons competent to perform such tasks at the location where that part of the work is being manufactured or fabricated. All such tests will be in accordance with the methods prescribed by the American Society for Testing and Materials or such other applicable organization as may be required by law, good practice, or the contract documents.**

If any work which is required to be inspected, tested, or approved, is covered up without written approval or consent of the Owner or Owner's Representative, it must, if requested by the Owner or Owner's Representative, be uncovered for observation and testing at the Contractor's expense. The cost of all such inspections, tests, and approvals shall be borne by the Contractor unless otherwise provided. Any work which fails to meet the requirements of such tests, inspections or approval, and any work which meets the requirements of any such tests or approval but does not meet the requirements of the contract documents shall be considered defective. Such defective work shall be corrected at the Contractor's expense.

Neither observations by the Owner or Owner's Representative, nor inspections, tests, or approvals made by Owner, Owner's Representative, or other persons authorized under this agreement to make such inspections, tests, or approvals, shall relieve the Contractor from his obligation to perform the work in accordance with the requirements of the contract documents.

22. **DEFECTS AND THEIR REMEDIES:** **It is further agreed that if any part of the work or any material brought on the site for use in the work, is deemed by the Owner or Owner's Representative as unsuitable or not in conformity with plans, specifications, and contract documents, the Contractor shall, after receipt of written notice from the Owner's Representative, immediately remove such material and rebuild or otherwise remedy such work so that it shall be in full accordance with this contract. It is further agreed that any remedial action shall be at Contractor's expense.**

23. **CHANGES AND ALTERATIONS:** **The Contractor further agrees that the Owner may make such changes and alterations as the Owner deems necessary, in the line, grade, form, dimensions, plans or materials for the work, either before or after the beginning of the construction, without affecting the validity of this contract and the accompanying bond.**

24. **CHANGES IN THE WORK AND ADJUSTMENT OF CONTRACT PRICE:**

A. Changes in the Work:

The Contract Documents may be amended or supplemented by a Change Order, Work Change Directive or a Field Order.

1. Change Orders:

If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Time, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not

affect the Contract Price or Contract Time.

Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications or otherwise), or (3) other engineering or technical matters, without the recommendation of the Owner's Representative. Such an amendment shall be set forth in a Change Order.

Nothing in this Section is intended to permit an increase of the Contract Price in excess of the limit set forth in TEX. LOC. GOV'T CODE ANN. §252.048 or its successor statute.

2. Work Change Directive:

A Work Change Directive is a written directive to Contractor issued on or after the Effective Date of the Contract, signed by the Owner and the Owner's Representative, ordering an addition, deletion, or revision in the Work. A Work Change Directive will not change the Contract Price or the Contract Time but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Time; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including the section regarding change of Contract Price.

Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Time, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Time, or both, no later than 60 days after issuance of the Work Change Directive.

Failure by the Contractor to commence work identified in a Work Change Directive within the time specified by the Owner's Representative, or to complete the work in a reasonable period of time, may be determined by Owner to be a material breach of the Contract.

3. Field Orders:

The Owner or Owner's Representative may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Time and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner

and on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Time, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

B. Adjustments in Contract Price:

1. Adjustments in Contract Price are accomplished by Change Order and are based on the following methods:

A. Mutual acceptance of fixed price, properly itemized and supported by sufficient data to permit evaluation;

B. Unit prices stated in the Contract or subsequently agreed upon;

C. Cost to be determined in a manner agreed upon by the Parties and mutually acceptable fixed or percentage fee; or

D. As provided in Paragraph 2

2. If the Contractor does not agree with a change in Contract Price or Contract Time, or the method for adjusting them specified in the Work Change Directive, within 21 days from date of the Work Change Directive's issuance, method and adjustment are determined by Owner's Representative. If the Contractor disagrees with the Owner's Representative's determination they then may file a Claim in accordance with the claims section of these general conditions.

3. If the Owner determines a method and adjustment in Contract Price, the Contractor shall provide, in a form as Owner's Representative may prescribe, appropriate supporting data for items submitted under Paragraph 4. Failure to submit the data within 21 days of request for the data by the Owner's Representative shall constitute waiver of a Claim.

4. Unless otherwise provided in the Contract, costs for the purposes of change orders are limited to the following:

A. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise and payroll taxes, workers'

compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by the Owner. The maximum cost of labor for changes in the Work is 55%.

B. Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed.

C. Rental costs of machinery and equipment, exclusive of hand tools, whether rented from Contractor or others.

D. Costs of premiums for Bonds and insurance and permit fees related to the change in the Work.

E. Additional costs of direct supervision of work and field office personnel directly attributable to the change.

F. Allowances for Overhead and Profit.

5. Overhead Profit Percent Markup

	OH	Profit
To Contractor for Work performed by Subcontractors:	**5**	**0**
To Sub-Contractor for Work performed by 2nd Tiers:	**5**	**0**
To Contractor and Sub-Contractor for Work Performed by their firms:	**10**	**5**

25. <u>DISCREPANCIES AND OMISSIONS:</u> It is further agreed that it is the intent of this contract that all work described in the proposal, the specifications, plans and other contract documents, shall be done for the prices quoted by the Contractor and that such price shall include all appurtenances necessary to complete the work in accordance with these contract documents as interpreted by Owner's Representative.

If the Contractor finds any discrepancies, omissions, or ambiguities in the plans, specifications, or contract documents, the Contractor should notify the Owner's Representative and obtain clarification and/or correction to such discrepancies, omissions, or ambiguities *before* the bid opening time. It shall be considered that the Contractor fully understands the work to be performed and has provided sufficient sums in the proposal to complete the work in accordance with these plans. It is further understood that any request for clarification must have been submitted no later than five (5) business days prior to opening of bids.

26. <u>RIGHT OF OWNER TO MODIFY METHODS AND EQUIPMENT:</u> If, at any time, the methods or equipment used by the Contractor are found to be inadequate to

secure the quality of work or the rate of progress required under this contract, the Owner or Owner's Representative may order the Contractor, in writing, to increase safety or improve character and efficiency, and the Contractor shall comply with such order.

If at any time the work force of the Contractor is inadequate for securing the progress of the contract, as determined by the Owner's Representative or Engineer, the Contractor shall, if so ordered in writing, increase the workforce or equipment, at Contractor's sole expense, to such extent as to give reasonable assurance of compliance with the schedule of progress.

27. **INDEMNIFICATION; PROTECTION AGAINST ACCIDENT TO EMPLOYEES AND PUBLIC: The Contractor shall procure Workmen's Compensation Insurance with an insurance company licensed to transact business in the State of Texas. Such policy shall comply with the Workmen's Compensation laws of the State of Texas. The Contractor shall at all times exercise reasonable precaution for the safety of employees and others on or near the work site and shall comply with all applicable provisions of federal, state, and municipal laws and building and construction codes. All machinery and equipment and other physical hazards shall be guarded in accordance with the "Manual of Accident Prevention in Construction" of Associated General Contractors of America, except where incompatible with federal, state or municipal laws or regulations.**

INDEMNITY CLAUSE: THE CONTRACTOR, SURETIES, AND INSURANCE CARRIERS SHALL DEFEND, INDEMNIFY AND SAVE HARMLESS THE OWNER AND ALL OF ITS OFFICERS, AGENTS AND EMPLOYEES FROM AND AGAINST ANY CLAIMS, LOSSES, DAMAGES, CAUSES OF ACTION, SUITS AND LIABILITY OF EVERY KIND, INCLUDING ALL EXPENSES ASSOCIATED WITH DEFENSE AGAINST THE CLAIM, WHERE THE CLAIM/LOSS/DAMAGE/CAUSE OF ACTION/SUIT/LIABILITY IS BASED ON ANY TORTIOUS OR NEGLIGENT ACT, OMISSION OR FAULT OF THE CONTRACTOR OR ANY SUBCONTRACTOR, THEIR AGENTS OR EMPLOYEES.

The Contractor or any subcontractor shall provide necessary barricades, warning lights, or signs. Contractor shall forfeit to Owner an amount equal to any assessment against the Owner or any of its officers, agents, or employees for the payment of any judgment, including attorney fees, or portion thereof, resulting to Contractor's negligence. The safety precautions taken shall be the sole responsibility of the Contractor. Inclusion of this paragraph in the Agreement, as well as any notice which may be given by the Owner or the Owner's Representative concerning omissions under this paragraph as the work progresses, are intended as reminders to the Contractor of the Contractor's duty and shall not be construed as any assumption of duty to supervise safety precautions by either the Owner or Owners Representative.

Note that there are several indemnity clauses throughout the Contract Documents.

Notwithstanding any provision to the contrary, if there are conflicting enforceable indemnity provisions, then the clause that provides the most favorable indemnification to the Owner shall prevail.

28. **CONTRACTOR'S INSURANCE: The Contractor shall refer to Invitation to Bid for required insurance.**

29. **PROTECTION AGAINST CLAIM OF SUBCONTRACTORS, LABORERS, MATERIALMEN, AND FURNISHERS OF MACHINERY, EQUIPMENT AND SUPPLIES: THE CONTRACTOR AGREES TO INDEMNIFY AND SAVE THE OWNER HARMLESS FROM ALL CLAIMS ARISING OUT OF ANY DEMANDS OF SUBCONTRACTORS, LABORERS, WORKERS, MECHANICS, MATERIALMEN, AND FURNISHERS OF MACHINERY AND PARTS THEREOF; ANY EQUIPMENT, POWER TOOLS, ALL SUPPLIERS, INCLUDING COMMISSARY, INCURRED IN THE FURTHERANCE OF THE PERFORMANCE OF THIS CONTRACT. When Owner so desires, and along with demand for final payment, the Contractor shall furnish satisfactory evidence that all obligations to third parties set forth above have been paid, discharged or waived.**

If during the progress of the work, Contractor shall allow any indebtedness to accrue for work furnished by any of those designated in the preceding paragraph and shall fail to pay and discharge any such indebtedness within five (5) days after demand is made, then Owner may, during the period for which such indebtedness shall remain unpaid, withhold from the unpaid portion of this contract, a sum equal to the amount of such unpaid indebtedness or may apply the sum so withheld to discharge any such indebtedness at Owner's option.

30. **PROTECTION AGAINST ROYALTIES OR PATENTED INVENTION: The Contractor shall pay all royalties and license fees. Contractor shall provide for the use of any design, device, material or process covered by patents or copyrights by suitable legal agreement with the Patentee or Owner thereof.**

The Contractor shall defend all suits or claims for infringement of any patent or copyrights and shall indemnify, defend and save the Owner harmless from any loss on account thereof. Owner shall defend all such suits and claims and shall be responsible for all such loss when a particular manufacturer or manufacturers is specified or required in these contract documents by Owner; provided, however, if choice of alternate design, device, material or process is allowed to the Contractor, then Contractor shall indemnify, defend, and save Owner harmless from any loss on account thereof.

If the material or process specified or required by Owner is a patent infringement, the Contractor shall be responsible for such loss if the Contractor had the option to use other materials or processes and did not

promptly gives written notice to the Owner prior to such infringement.

31. **LAWS AND ORDINANCES: The Contractor shall at all times observe and comply with all Federal, State and local laws, codes, ordinances, rules and regulations. Contractor shall indemnify, defend, and save harmless the Owner against any claims arising from the violation of any such laws and ordinances, codes and regulations, whether by the Contractor, Contractor's employees or third parties. If the Contractor observes that the plans and specifications are at variance with a law, ordinance, code, rule or regulation, Contractor shall promptly notify the Owner's Representative in writing and request the necessary changes with adjustments as provided in the contract for changes in the work. If the Contractor performs any work contrary to such laws, ordinances, rules, codes and regulations, and without such notice to the Owner's Representative, Contractor shall bear all costs of remediation. This paragraph additionally requires Contractor to obtain all necessary permits at Contractor's expense.**

The Owner is a municipal corporation of the State of Texas. All laws applicable to municipal corporations, or the conditions or manner under which the Owner may enter into contracts, shall be controlling and shall be considered part of this contract to the same effect as though embodied herein. Provisions in violation of applicable laws are void.

32. **ASSIGNMENT AND SUBLETTING: The Contractor agrees to retain personal control and give personal attention to the fulfillment of this contract. The Contractor further agrees that subletting of any portion or feature of the work, or materials required in the performance of this contract shall not relieve the Contractor from the Contractor's full obligation to the Owner.**

33. **TIME FOR COMPLETION AND LIQUIDATED DAMAGES: Time for completion is set out in the Invitation to Bid for this project, usually in the paragraph concerning "Liquidated damages". It is hereby understood and mutually agreed by and between the Contractor and the Owner, that the date of beginning and time for completion as specified in the Contract of work to be done hereunder are essential conditions of this contract; and it is further mutually understood and agreed that the work embraced in this contract shall be commenced on a date to be specified in the Notice to Proceed.**

If the Contractor should neglect, fail, or refuse to complete the work within the time specified, or any proper extension of time granted by the Owner, then Contractor agrees that the Owner may withhold permanently from Contractor's total compensation, the sum stated in the Special Conditions of the Agreement Paragraph 18, not as a penalty, but as liquidated damages for the breach of the contract as set forth for each and every calendar day that the Contractor is in default after the time stipulated for completing the work.

It is expressly understood and agreed, by and between Contractor and the Owner, that the time for the completion of the work described is a reasonable time for the completion of the same, taking into consideration the average climatic change and conditions and usual industrial conditions prevailing in this locality.

The amount for liquidated damages is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty in fixing and ascertaining actual damages the Owner would in such event sustain. The amount is agreed to be damages the Owner would sustain and shall be retained by the Owner from current periodical estimates for payments or from final payment.

It is further agreed and understood between the Contractor and Owner that time is of the essence of this contract.

34. **<u>TIME AND ORDER OF COMPLETION:</u> It is the meaning and intent of this contract, unless otherwise specifically provided, that the Contractor shall be allowed to prosecute the work at such time and sessions, in such order of precedence, and in such manner as shall be most conductive to economy of construction. However, the order and time of prosecution shall be such that the work shall be substantially completed as a whole and in part, in accordance with this contract, the plans and specifications and within the time of completion designated in the Invitation to Bid and or proposals. When the Owner is having other work done, the Owner's Representative may direct the time and order of work done under this contract, so that conflicts will be avoided and the construction of the various jobs shall be harmonized.**

The Contractor shall submit, along with the first request for payment, and at such other times as requested by the Owner's Representative, schedules that shall show the order in which the Contractor proposes to carry on the work, with dates at which the Contractor will start the several parts of the work, and estimated dates of completion of the several parts.

35. **<u>EXTENSION OF TIME:</u> The Contractor agrees that the Contractor's proposal has been submitted in full recognition of the time required for the completion of this project, taking into consideration the average climatic range, possible rain days, and industrial conditions prevailing in this locality, and has considered the liquidated damage provisions of paragraph 33. Contractor shall not be entitled to an extension of time on this contract, except when the work has been delayed by an act or neglect of the Owner, Owner's Representative, employees of the Owner or other Contractors employed by the Owner; by changes ordered in the work; by strike, walk-outs, acts of God, or public enemies, fire or flood. Contractor may request extensions of time to complete the contract if he does so in writing to the Owner's Representative within ten (10) business days after the event causing the delay. Untimely requests for**

extensions of time shall be denied and the Contractor's right, if any, to payment and or extra time is waived. Additionally, Contractor shall notify Owner promptly whenever there is reason to believe that Contractor may be unable to complete the project timely.

The Owner's Representative decide the request for additional time, and notify the Contractor. Should the Contractor disagree with the action of the Owner's Representative denying or reducing the Contractor's request for additional time, the Contractor shall present the matter by certified mail to the Owner with a copy to the City Manager within ten (10) business days. Denied requests not timely submitted for review as set out herein are waived. It shall be a condition precedent for mediation and then litigation if necessary, that the Owner denied or reduced Contractor's request for additional time. To the extent the extension is Granted, the Contractor must promptly make a written request for a Change Order.

36. <u>HINDRANCES AND DELAYS:</u> In executing the contract agreement, the Contractor agrees that in undertaking to complete the work within the required time, the Contractor has taken into consideration and made allowances for all hindrances and delays incident to such work, whether arising out of delays in securing material or workers or otherwise. No charge shall be made by the Contractor for hindrances or delays from any cause during the progress of any part of the work embraced in this contract except if *a Change Order has been obtained* because the work was stopped by order of the Owner or Owner's Representative for the Owner's convenience, in which event such expense as in the judgment of the Owner's Representative and the Owner that is caused by such stoppage shall be paid by Owner to Contractor. Costs caused by delays or activities of a subcontractor or other third parties under the supervision of the Contractor, shall be the responsibility of the Contractor.

Force Majeure: If by reason of Force Majeure either party shall be rendered unable, wholly or in part, to carry out its responsibilities under this contract by any occurrence by reason of Force Majeure, then the party unable to carry out its responsibility shall give the other party notice and full particulars of such Force Majeure in writing within a reasonable time after the occurrence of the event, and such notice shall suspend the party's responsibility for the continuance of the Forced Majeure claimed, but for no longer period.
Force Majeure means acts of God, floods, hurricanes, tropical storms, tornadoes, earthquakes, or other natural disasters, acts of public enemy, acts of terrorism, sovereign conduct, riots, civil commotion, strikes or lockouts, and other causes that are not occasioned by either Party's conduct which by the exercise of due diligence the party is unable to overcome and which substantially interferes with operations.

37. <u>QUANTITIES AND MEASUREMENTS:</u> No extra or customary

measurements of any kind will be allowed, but the actual measured or computed length, area, solid contents, number and weight only shall be considered, unless otherwise specifically provided.

In the event this contract is let on a unit price basis, then Owner and Contractor agree that this contract, including the specifications, plans and other contract documents are intended to show clearly all work to be done and material to be furnished hereunder. Where the estimated quantities are shown for the various classes of work to be done and material to be furnished under this contract, they are approximate and are to be used only as a basis for estimating the probable cost of the work and for comparing their proposals offered for the work. It is understood and agreed that the actual amount of work to be done and the materials to be furnished under this contract may differ somewhat from these estimates, and that where the basis for payment under this contract is the unit price method, payment shall be for the actual amount of work done and materials furnished on the project. *Notwithstanding the foregoing, however, the Contractor must notify the Owner's Representative in writing (with a copy to the City Manager) as soon as the Contractor is within $15,000 of the amount authorized for the entire project by City Council less retainage. The Contractor will not be paid more than the amount authorized by City Council unless the City Council approves a Change Order increasing the total contract amount. Should the Contractor fail to give this advance notice and continue to work on the project so that the total payment due would exceed the amount authorized by City Council, the Contractor waives any and all rights to payment for the work exceeding the authorized sum.*

38. **PROTECTION OF ADJOINING PROPERTY:** **The Contractor shall take proper measures to protect the adjacent or adjoining property or properties which may be injured or seriously affected by any process of construction. Contractor shall be liable for any and all claims for such damage resulting from the Contractor's failure to fully protect all adjacent property. THE CONTRACTOR AGREES TO INDEMNIFY, DEFEND, SAVE AND HOLD HARMLESS THE OWNER AGAINST ANY CLAIMS FOR DAMAGES (AND EXPENSES FOR DEFENDING SAME) DUE TO ANY INJURY TO ANY ADJACENT OR ADJOINING PROPERTY, ARISING OR GROWING OUT OF CONTRACTOR'S PERFORMANCE OF THIS CONTRACT. Such indemnity shall not apply to any claim arising out of the mere existence or character of the work.**

39. **PRICE FOR WORK:** **In consideration of the furnishing all necessary labor, equipment and material, and the completion of all work by the Contractor, and on the delivery of all material embraced in this contract in full conformity with the specifications and stipulations, the Owner agrees to pay the Contractor the prices set forth in the attached proposal, which has been made a part of this contract. The Contractor agrees to receive such prices as full compensation, including but not limited to furnishing all materials and all**

labor required for the work, and for all expenses incurred by the Contractor, in performing the same, in the manner and according to this Agreement, the attached specifications, plans, contract documents and requirements of Owner's Representative.

40. **PAYMENTS:** **No payments made or certificates given shall be considered as conclusive evidence of the performance of the contract, either wholly or in part. No payments made or certificates given shall be considered as acceptance of defective work. Contractor shall, at any time requested during the progress of the work, furnish the Owner or Owner's Representative with a verifying certificate showing the Contractor's total outstanding indebtedness in connection with the work. Before final payment is made, Contractor shall satisfy Owner, by affidavit or otherwise, that there are no outstanding claims for payment, or liens against Owner's premises, by reason of any work under the contract.**

Acceptance by Contractor of final payment of the contract price shall constitute a waiver of all Contractor's claims against Owner which have not been timely filed as provided in this contract.

41. **PARTIAL PAYMENTS:** **On or before the 5th day of each month the Contractor shall submit to Owner's Representative an application for partial payment. Owner's Representative shall review the application for partial payment and the progress of the work made by the Contractor. If Owner's Representative finds Contractor's application to be in order, Owner's Representative shall prepare a certificate for partial payment showing as completely as practical the total value of the work done by the Contractor up to and including the last day of the preceding month and the value of all sound materials delivered on site of the work that are to be fabricated into the work.**

The Owner shall then pay the Contractor on or before the fifteenth day of the current month the total amount of the Owner's Representative Certificate of Partial Payment, less a percentage retained until final payment. The percentage of payment retained is determined by the contract amount. Five (5) percent shall be retained, if total contract award is $400,000 or more. If total contract award is less than $400,000, 10% will be retained. Such 5 or 10 percent shall be retained until final payment is made. However, it is understood that in case the whole work is near to completion and some unexpected and unusual delay occurs due to no fault or negligence on the part of the Contractor, the Owner *may* upon written recommendation of Owner's Representative pay a reasonable and equitable portion of the retained percentage due Contractor.

42. **FINAL COMPLETION AND ACCEPTANCE:** **Within thirty-one (31) days after the Contractor has given the Owner's Representative written notice that**

the work has been completed, or substantially completed, the Owner's Representative and the Owner shall inspect the work. If

(a) **the work is found completed or substantially completed in accordance with the contract documents, and**

(b) **the Contractor has provided the Owner's Representative a set of "as built" drawings, the Owner's Representative shall issue to the Owner and Contractor a certificate of completion. The work shall not be considered "completed" or "substantially completed" in accordance with the contract until such time as the certificate has been issued; and no certificate shall be issued until the Owner has been given "as-built" drawings of the project by the Contractor.**

43. **FINAL PAYMENT: Upon the issuance of the Certificate of Completion the Engineer shall make final measurements and prepare a final statement of the value of all work performed and materials furnished under the terms of the Agreement plus a statement of all outstanding and unsettled claims and a list of any work that Contractor must correct or complete and shall certify this statement to the Owner. The Owner shall pay to the Contractor on or before the 31st day after the date of the Certificate of Completion the balance due the Contractor under the terms of the Agreement, provided the Contractor has fully performed all contractual obligations under the terms of this Contract. The payment shall become due in any event upon performance by the Contractor. Neither the Certificate of Completion, the final payment, nor any provision in the Contract Documents, shall relieve the Contractor of any obligation under this contract, or of the obligation for fulfillment of any warranty which may be required in the Special Conditions of this contract or required in specifications made a part of this contract. Acceptance of final payment by the Contractor, a subcontractor, or a material supplier shall constitute a waiver of claims by that payee, except for those claims previously made in writing and identified in writing by that payee as unsettled at the time of final application for payment.**

44. **CORRECTION OF WORK BEFORE FINAL PAYMENT FOR WORK: Contractor shall promptly remove from Owner's premises all materials whether actually incorporated in the work or not, condemned by the Owner's Representative. Contractor shall at Contractor's own expense promptly replace such condemned materials with other materials conforming to the requirements of the contract. Contractor shall also bear the expense of restoring all work of other Contractors damaged by any such removal or replacement. If Contractor does not remove and replace any such condemned work within a reasonable time after a written notice by the Owner or the Owner's Representative, Owner may remove and replace the materials at Contractor's expense.**

45. **CORRECTION OF WORK AFTER FINAL PAYMENT: Neither the final**

payment nor certificate of completion nor any provision in this contract shall relieve the Contractor of responsibility for faulty materials or workmanship. Contractor shall immediately remedy any defects and pay for any damage to other work resulting from any defects that appear within a period of one (1) year from the date of final completion. The Owner or Owner's Representative shall give notice of observed defects with reasonable promptness.

46. **PAYMENT WITHHELD:** **The Owner may, upon subsequently discovering defects in the work, withhold payment if any monies remain and/or nullify the whole or part of any certificate to such extent as may be necessary to protect the Owner from loss caused by:**

- **(a) Defective work not remedied.**
- **(b) Claims filed or reasonable evidence indicating possible filing of claims.**
- **(c) Failure of the Contractor to make payments promptly to sub-Contractors or to pay for material or labor; or**
- **(d) Damage to another Contractor.**

When the above are cured, or the Contractor provides a surety bond protecting the amounts withheld, satisfactory to the Owner, payment shall be made.

47. **TIME OF FILING CLAIMS: It is further agreed by both parties that all questions of dispute or adjustment presented by the Contractor shall be in writing and filed with the Owner's Representative within ten (10) business days after the disputed action is known to Contractor or could have been known if Contractor had been diligent, Contractor must obtain a written denial from the Owner's Representative to proceed further with any claim. Contractor must then (within 10 business days) file a written objection and appeal of the disputed decision, to the Owner (with copy to the City Manager in the same time period), fully explaining the disputed matter.**
In case the Contractor does not agree with the Owner's decision and wishes to litigate that decision, Contractor shall—within 10 days of the Owner's decision-- first file a written demand for mediation with the Owner's Representative with a copy to the City Manager, Mediation is a condition precedent to litigation. It is further agreed that acceptance by the Contractor of the final payment shall be a bar to any claim by Contractor, except as noted otherwise in the contract documents. See also section 14.

48. **ABANDONMENT BY CONTRACTOR:** **In case the Contractor should abandon and fail or refuse to resume work within ten (10) days after written notification from the Owner or the Owner's Representative, or if the Contractor fails to comply with the orders of the Owner's Representative, when such orders are consistent with this contract, the Owner shall notify the Surety on the bond, in writing. The Owner shall direct the Surety to complete the work and a copy of said notice shall be delivered to the Contractor.**

After receiving a copy of Owner's notice to the Surety, the Contractor shall not remove from the job site any machinery, equipment, tools, materials, or supplies, materials and equipment for use on the job, by the Owner, the Surety of the Contractor, or another Contractor, for completion of the work. The Contractor shall not receive any rental or credit for such use. Contractor agrees and understands that the use of such equipment and materials will ultimately reduce the cost to complete the work and be reflected in the final settlement.

In case the Surety should fail to commence compliance with Owner's notice for completion, within ten (10) days after receipt of such notice, then the Owner may provide for completion of the work in either of the following manners:

(a) **The Owner may employ such force of workers, use of machinery, equipment, tools, materials and supplies as Owner may deem necessary to complete the work. Owner may charge the expense of such labor, machinery, equipment, tools, materials and supplies to Contractor, and the expense so charged shall be deducted and paid by the Owner out of monies as may be due, or that may become due to the Contractor under and by virtue of this agreement. If such expense is less than the sum which would have been payable to Contractor under this contract, if the same had been completed by the Contractor, then Owner shall pay the difference to the Contractor. In case such expense is greater than the sum which would have been payable under this contract, if the same had been completed by the Contractor, then the Contractor or the Contractor's Surety shall pay the amount of such excess to the Owner; or**

(b) **The Owner, under sealed bids, after notice published as required by law, at least twice in a newspaper having a general circulation in the County of location of the work, may let the contract for the completion of the work under substantially the same terms and conditions which are provided in this contract. In case of any increase in cost to the Owner under the new contract, as compared to what would have been the cost under this contract, such increase shall be charged to the Contractor and the Surety shall be and remain bound therefore. However, should the cost to complete any such new contract prove to be less than that which would have been the cost to complete the work under this contract, the Contractor and Contractor's Surety shall be credited with the difference between the new contract and this contract.**

When the work has been completed or substantially completed, the Contractor and Surety shall be so notified and a certificate of completion issued, as provided in paragraph 42.

A complete itemized statement of the contract accounts, certified to by the

Owner's Representative as being correct shall be prepared and delivered to Contractor and Contractor's Surety. Upon delivery to the Contractor or Contractor's Surety, the Contractor or Surety shall pay the balance due, if any, as reflected by the statement, within thirty (30) days after the date of certificates of completion. Contractor and Surety shall be held jointly and severally liable for any balance due.

In the event the statement of accounts shows that the cost to complete the work is less than the cost to the Owner had the work been completed by the Contractor under the terms of this contract, or when the Contractor and Surety shall pay the balance shown to be due by them to the Owner, then all machinery, equipment, tools, materials or supplies left on the site of the work shall be released to the Contractor and/or its Surety. Should the cost to complete the work exceed the contract price, and amount due the Owner within the time designated, and there remains any machinery, equipment, tools, materials or supplies on the site of the work, Owner shall mail notice of amounts due, together with an itemized list of such equipment and materials to the Contractor and its Surety. After mailing such notice, such property shall be held at the risk of the Contractor and its Surety, subject only to the duty of the Owner to exercise ordinary care to protect such property.

After fifteen (15) days from the date of receipt of notice, the Owner may sell all machinery, equipment, tools, materials or supplies and apply the proceeds, less costs and expense of the sale to the credit of the Contractor and its Surety. Such sale may be made at either public or private sale, with or without notice, as the Owner may elect. The Owner shall release any machinery, equipment, tools, materials or supplies which remain on the job site that belong to persons other than the Contractor or its Surety, to their lawful owners.

49. **<u>ABANDONMENT BY OWNER:</u>** **If the Owner shall fail to comply with the terms of this contract and refuses to comply with such terms within ten (10) days after the receipt of written notification by the Contractor, then the Contractor may suspend or wholly abandon the work, and may remove all machinery, tools and equipment and all materials on the ground that have not been included in the payments to the Contractor or incorporated into the work.**

The Owner's Representative shall make an estimate of the total amount earned by the Contractor, which estimate shall include the value of all work actually completed by said Contractor, at the prices stated in the attached proposal, the value of all partially completed work, at fair and equitable price, and the amount of all authorized Extra Work performed at the prices agreed upon or as provided for by the terms of this contract, and a reasonable sum to cover the cost of any provisions made by the Contractor to complete the work, and which cannot be utilized. The Owner's Representative shall then make a final statement of the balance due the Contractor by deducting from the above

estimate all previous payments by the Owner and all other sums that may be retained by the Owner under the terms of this Agreement. Owner's Representative shall certify the final statement to the Owner who shall pay to the Contractor on or before thirty (30) days after the date of Owner's receipt of certification, the balance shown by the final statement. In no event shall Owner owe more than the amount authorized by City Council.

50. **BONDS:** **The successful bidder shall be required to furnish a performance bond and payment bond, in accordance with Tex. Gov't. Code, section 2253.001, et seq., in the amount of 100% of the total contract price, in the event the contract price exceeds $50,000.00. If the contract price does not exceed $50,000.00 and payment for work shall be made in one lump sum payment after completion and final acceptance of the work, the Owner shall not require the statutory bonds.**

All bonds, if required, shall be submitted on forms supplied by the Owner, and executed by an approved surety company authorized to do business in the State of Texas. It is further agreed that this contract shall not be in effect until such bonds are so furnished and accepted by the Owner.

51. **SPECIAL CONDITIONS:** **In the event special conditions are contained in these contract documents and such special conditions conflict with any of the general conditions contained in these documents, the special conditions shall control.**

52. **LOSSES FROM NATURAL CAUSES:** **Unless otherwise stated, all loss or damage to the Contractor arising out of the nature of the work to be done or from unusual obstructions or difficulties which may be encountered in the prosecution of the work, shall be sustained and borne by the Contractor at Contractor's own cost and expense.**

53. **INDEPENDENT CONTRACTOR:** **Contractor is and shall remain an independent Contractor, with full, complete and exclusive power and authority to direct, supervise, and control Contractor's own employees and to determine the method of the performance of the work covered by this contract.**

The fact that the Owner or Owner's Representative shall have the right to observe Contractor's work during Contractor's performance and to carry out the other prerogatives which are expressly reserved to and vested in the Owner or Owner's Representative, is not intended to and shall not at any time change or affect the status of the Contractor as an independent Contractor, with respect to either the Owner or Owner's Representative or to the Contractor's own employees or to any other person, firm or corporation.

54. **CLEANING UP:** **The Contractor shall at all times keep the premises free from accumulations of debris and at the completion of the work, shall remove all**

such debris and all tools, scaffolding and surplus materials and shall leave the worksite broom clean or its equivalent. The work shall be left in good order and condition. In case of dispute or should Contractor fail to clean the premises, Owner may remove the debris and charge the cost to the Contractor.

55. **CONTRACTOR'S RIGHT TO TERMINATE:** **The Contractor shall have the right to terminate the contract at any time when, through no fault of the Contractor, circumstances beyond the Contractor's control, such as a declared emergency, occur which prohibit the completion of the agreement as contemplated by the parties at the time of execution. Should the Contractor choose to terminate this agreement, except as set forth above, Contractor shall accrue no rights to full payment and shall receive only a pro rata payment for the work actually performed and accepted by Owner, and the amount of such payment shall be assessed by Owner. Should the Contractor choose not to terminate even though cause exists under this provision, liquidated damages, as set forth in these documents shall remain in full force and effect.**

56. **OWNER'S RIGHT TO TERMINATE CONTRACT:** **In the event any of the provisions of this contract are violated by the Contractor, or by any of his subcontractors, the Owner may serve written notice upon the Contractor and the Surety of its intention to terminate this contract. Such notices shall contain the reasons for such intention to terminate the contract. Unless within ten (10) days after the serving of such notice upon the Contractor, the violation or delay ceases and satisfactory arrangements for correction of any violation are made, the contract shall, upon the expiration of the ten (10) days, cease and terminate. In exceptional cases where life or property is in danger, Owner may terminate the Contract immediately. In the event of any termination, the Owner shall immediately serve notice of termination upon the Surety and Contractor. The Surety shall have the right to perform the contract. If the Surety does not commence performance of the contract within ten (10) days from the date of the receipt of Owner's notice of termination, the Owner may assume the work and prosecute the same at the expense of the Contractor and its Surety. The Contractor and its Surety shall be liable to the Owner for any excess cost occasioned by the Owner. 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. The Owner may also terminate as set out in the bid documents.**

57. **SEVERABILITY CLAUSE: The phrases, clauses, sentences, paragraphs or sections of these conditions are severable. If any phrase, clause, sentence, paragraph, or section of these conditions should be declared invalid by the final decree or judgment of any court of competent jurisdiction, such invalidity shall not affect any of the remaining phrases, clauses, sentences, paragraphs and sections of these conditions.**

58. **ENTIRE AGREEMENT:** **The contract between the parties includes these**

General Conditions, No modifications of, or waiver of any right under, the contract will be effective unless it is evidenced in writing executed by an authorized representative of each Party to the contract.

59. The parties agree that if there is litigation concerning this Contract, jurisdiction shall be in Texas state courts, and venue shall be in Galveston, County. Texas state law shall apply.

SPECIAL CONDITIONS OF THE AGREEMENT

1. **ABBREVIATIONS DEFINED:** **Abbreviations, wherever used in the various documents of the contract, are defined as follows:**

Abbreviation:	Definition:
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AIEE	American Institute of Electrical Engineers
AISC	American institute of Steel Construction
API	American Petroleum Institute
AREA	American Railway Engineers Association
ASA	American Standards Association
Asph.	Asphalt
ASTM	American Society of Testing and Materials
AT&SF	Atchinson, Topeka and Santa Fe Railroad
Ave.	Avenue
AWS	American Welding Society
AWWA	American Waterworks Association
Blvd.	Boulevard
CI	Cast Iron
CL	Center Line
cm	Centimeter
CO	Cleanout
Conc.	Concrete
CGMP	Corrugated Galvanized Metal Pipe
Cu.	Cubic
Culv.	Culvert
CY	Cubic Yard
Dia.	Diameter
Dr.	Driveway
Elev.	Elevation
F	Fahrenheit
FS	Federal Specifications
Ft.	Foot or Feet
'	Foot or Feet
Gal.	Gallon
HL&P	Houston Lighting & Power Co.
HP	Horsepower
Hr.	Hour
ID	Inside Diameter
In.	Inch or Inches
"	Inch or Inches
IPCEA	Insulated Power Cable Engineers Association
Kg.	Kilogram
Lb.	Pound
LF	Linear Foot or feet
M	Meter

Max.	**Maximum**
MH	**Manhole**
Min.	**Minute**
mm	**Millimeter**
No.	**Number**
OD	**Outside Diameter**
%	**Percent**
PI	**Plasticity Index**
psi	**Pounds per Inch**
Sq In	**Square Inch**
PVC	**Polyvinyl Chloride**
R	**Radius**
Reinf.	**Reinforce or Reinforcing**
R/W	**Right of Way**
R of W	**Right of Way**
ROW	**Right of Way**
San.	**Sanitary**
Sec.	**Second**
Sq.	**Square**
St.	**Street**
Std.	**Standard**
SWBT	**Southwestern Bell Telephone Co.**
SY	**Square Yard**
SUG	**Southern Union Gas**
TXDOT	**Texas Department of Transportation**
Vert.	**Vertical**
Vol.	**Volume**
WUT	**Western Union Telegraph Company**
yd.	**Yard**

2. **MEASUREMENT:** **Measurements required for construction or for determination of pay quantities shall be in accordance with the United States Standards Measurements and Weights.**

3. **DATE OF SPECIFICATIONS:** **All reference to standard specifications or manufacturer's installation directions shall mean the latest edition.**

4. **FIGURED DIMENSIONS TO GOVERN:** **Dimensions and elevations indicated on the drawings shall be accurately followed even though different from scaled measurements. No work indicated on the drawings, the dimensions of which are not indicated, shall be executed until dimensions have been obtained from the Engineer.**

5. **CONTRACTOR TO CHECK DRAWINGS AND SCHEDULES: The Contractor shall check all dimensions, elevations, and quantities indicated on the drawings and schedules furnished by the Engineer. The Contractor shall promptly notify the Engineer of any discrepancy between the drawings and the conditions on the ground, or any error or omission in drawings, or in the layouts as given by stakes, points, or instructions which the Contractor may discover in the course of the work. The Contractor will not be allowed to take advantage of any error or omission in the**

drawings or contract documents.

Full instructions will be furnished by the Engineer should such an error or omission be discovered and the Contractor shall carry out such instructions as if originally specified.

6. <u>SHOP DRAWINGS, PRODUCT DATE AND SAMPLES:</u> Shop drawings are drawings, diagrams, schedules and other data specifically prepared for the work by the Contractor or any subcontractor, manufacturer, supplier or distributor to illustrate some portion of the work.

Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate a material, product or system for some portion of the work.

Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the work shall be judged.

The Contractor shall provide, review, approve, and submit, with reasonable promptness and in such sequence as to cause no delay in the work or in the work of the Owner or any separate Contractor, all shop drawings, product data and samples required by the contract documents.

By approving and submitting shop drawings, product data, and samples, the Contractor represents that the Contractor has determined and verified all materials, field measurements, and field construction criteria related thereto, or shall do so, and that the Contractor has checked and coordinated the information contained within such submittal with the requirements of the work and of the contract documents.

As the Engineer's review is only for general conformance with the requirements of the contract documents, the Contractor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Engineer's approval of shop drawings, product data or samples, unless the Contractor has specifically informed the Engineer, in writing, of such deviation at the time of submission and the Engineer has given written approval to the specific deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Engineer's approval. The Contractor shall direct specific attention, in writing or on resubmitted shop drawings, product data or samples, to revisions other than those requested by the Engineer on previous submittal.

The Contractor shall be responsible for delays caused by rejection of the submittal of inadequate or incorrect shop drawings, product data or samples. The Contractor shall be responsible for ensuring that any "approved" copies of shop drawings bearing the approval of the Engineer are on the job site. The Contractor shall be responsible for providing all copies of approved shop drawings necessary for the construction operation.

The Contractor shall keep adequate records of submittal and approvals so that an accurate up-to-date record file is maintained at the job site at all times.

No portion of the work requiring submission of a shop drawing, product data, or sample shall be commenced until the submittal has been approved by the Engineer. All such portions of the work shall be in accordance with approved submittal.

7. **PRODUCTION OF WORK:** **Before beginning construction operations, the Contractor shall submit to the Engineer for approval a chart or brief outlining the manner of prosecution of the work that the Contractor intends to follow in order to complete the contract within the allotted time.**

8. **NOTIFICATION OF ENGINEER PRIOR TO START OF WORK:** **The Contractor shall notify the Engineer at least twenty-four (24) hours before beginning work at any point. The Contractor shall not open up new work to the detriment of work already begun. The beginning, sequence, and prosecuting of the work shall be governed by the approval of the Engineer.**

9. **MATERIALS AND EQUIPMENT:** **Unless specifically provided in each case, all materials and equipment furnished for permanent installation in the work shall conform to applicable standard specifications and shall be new, unused and undamaged, when installed or otherwise incorporated in the work. No such material or equipment shall be used by the Contractor for any purpose other then that intended or specified, unless such use is specifically authorized by the Owner.**

10. **EQUIVALENT MATERIALS AND EQUIPMENT:** **Whenever a material or article is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, the specific item mentioned shall be understood as establishing the type, function, and quality desired. Other manufacturer's products will be accepted provided sufficient information is submitted to allow the Engineer to determine that the products proposed are equivalent to those named. Such items shall be submitted for review by the procedure set forth above. Contractor shall not use such items unless written approval by the Engineer is obtained.**

    Request for review of equivalency will not be accepted from anyone except the Contractor and such request will not be considered until after the contract has been awarded.

11. **UTILITY SERVICE FOR CONSTRUCTION:** **Contractor shall contract for all utility service required for the construction of this project. Contractor shall pay all charges for same directly to the utility company involved. Contractor shall not operate any fire hydrants without first having a meter from the City of Galveston and having placed this meter on the hydrant. The Contractor shall operate fire hydrant(s) only with an approved hydrant wrench.**

12. **RIGHTS OF WAY AND EASEMENTS:** **The Owner will furnish all right-of-way easements required for the proposed work.**

13. **LOCATION OF AND DAMAGE TO EXISTING UTILITIES:** **The Contractor shall exercise caution to prevent damage to existing utilities during the progress of the construction work, taking care to locate same, where possible, in advance of the actual work. Upon written request by the Contractor, the Engineer will render assistance to**

the Contractor in determining the location of existing utilities by making such maps, records and other information as may be accessible to the Engineer. The accuracy of such information will not be guaranteed. The Contractor shall make good all damage to existing utilities resulting from Contractor's operations.

Where a pipe, duct or other structure of a utility is exposed, which in the opinion of the Engineer requires strengthening, altering or moving, the Contractor shall perform such work as the Owner may order, which may be paid for as extra work in accordance with the terms of the contract relating to extra work.

Should the Contractor, in the laying out of the work, encounter any pipe, underground utility, or structure, the location of which has not been furnished to him by the Engineer, the Contractor shall bring such conditions to the attention of the Engineer for a determination of the method to be used to remove or bypass obstructions.

14. **PROTECTION AND REPLACEMENT OF PROPERTY: Where necessary, Contractor shall remove signs or other obstructions, and replace all signs in their original condition and restore damaged property or make satisfactory restitution to the Owner.**

15. **SIGNS AND BARRICADES: All signs, barricades and other warning devices used to guide, warn or protect traffic in, around and through the construction area shall be provided and maintained by the Contractor in a manner suitable to and/or as directed by the Engineer. All such signs, barricades and warning devices shall conform to the Texas Manual on Uniform Traffic Control Devices, Part VI.**

16. **USE OF STREETS:**
    - **(a) The Contractor will be permitted to erect such barricades as the Contractor deems necessary to prohibit the encroachment of vehicular or pedestrian travel within the work area or storage area. However, no barricades shall be erected to obstruct the free passage to traffic in any highway, alley or street without the approval of the Director of Traffic and Transportation.**
    - **(b) Contractor shall not block ditches, inlets, fire hydrants, driveways, etc., without obtaining advance approval from the appropriate authorities. Where necessary, Contractor shall provide temporary drainage.**

17. **CONTRACTOR WARRANTY: The Contractor warrants that materials and equipment furnished under the contract will be of good quality and new, unless otherwise required or permitted by the contract documents. The Contractor warrants the work will be free from defects not inherent in the quality required or permitted, and the work will conform with the requirements of the contract documents. Work not conforming to the contract documents, including substitutions not properly authorized and approved, may be considered defective. Upon demand, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty shall apply to any extra work and corrective work, as well as the original work specified in the contract documents.**

18. **LIQUIDATED DAMAGES: Contractor shall be liable for liquidated damages in the amount specified in the Invitation to Bid for this project should the work not be**

completed within the period specified for completion of the project. Additionally, Contractor may be liable for the loss of any grant moneys associated with this project due to Contractor's delay.

19. <u>GENERAL PREVAILING WAGE RATES:</u> The City of Galveston has adopted the following schedule of general prevailing rate of per diem wages which establish the minimum wages which may be paid for labor on this contract. That schedule is shown in the General Decision Number provided within these documents.

The bidder's attention is directed to the provisions of Ch. 2258 of the Texas Government Code, and the requirements concerning such wage scales and payments by the Contractor of the prevailing rates of wages as established by the City of Galveston.

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

These prevailing wage rates are subject to change by the City prior to bid opening date. Any changes shall be issued by addenda.

20. <u>COMPLIANCE WITH AIR AND WATER ACTS:</u>

(a) In compliance with the Clean Air Act, as amended, 41 U.S.C. Sec. 7401 et. seq., and the regulations of the Environmental Protection Agency with respect thereto, the Contractor agrees that:

1) Any facility to be utilized in the performance of this contract or any subcontract shall not be a facility listed on the EPA List of Violating Facilities pursuant to 40 CFR 15.20.

2) Contractor shall comply with all requirements of Section 114 of the Clean Air Act, as amended.

(b) Materials utilized in the project shall be free of any hazardous materials, except as may be specifically provided for in the specifications.

If the Contractor encounters existing material on sites owned or controlled by the Owner or in material sources that are suspected by visual observation or smell to contain hazardous materials, the Contractor shall immediately notify the Engineer and the Owner. The Owner will be responsible for testing for and removal or disposition of hazardous materials on sites owned or controlled by the Owner. The Owner may suspend the work, wholly or in part during the testing, removal or disposition of hazardous materials on sites owned or controlled by the Owner.

21. <u>EQUAL EMPLOYMENT OPPORTUNITY</u>

(a) The Contractor will not discriminate against any employee or the applicant for employment because of race, color, religion, sex, gender, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, gender, or national origin. Such action shall include, but not be limited to the following: employment, promotion, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training,

including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the owner.

(b) **The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.**

(c) **The Contractor will cause the foregoing provisions to be inserted in all subcontracts for any work covered by this project so that such provisions will be binding upon each subcontractor, provided that the foregoing provisions shall not apply to contracts or subcontracts for standard commercial supplies or raw materials.**

(d) **The Contractor shall take affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions.**

(e) **The Contractor and all subcontractors are encouraged to participate in voluntary associations which assist in fulfilling their affirmative action obligations.**

(f) **The Contractor is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority.**

(g) **The Contractor shall not use the affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.**

(h) **The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts.**

(i) **Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents.**

22. **<u>AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES:</u>**

The Contractor will not discriminate against any employee or applicant for employment because of disability in regard to any position for which the employee or applicant for employment is qualified. The Contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified individuals with disabilities without discrimination based upon their disability in all employment practices such as the following: employment, promotion, demotion or transfer, recruitment, advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

23. **<u>DUTIES IMPOSED BY SECTION 109 OF THE HOUSING AND COMMUNTY DEVELOPMENT ACT OF 1974</u>:Contractor shall comply with Section 109 of the Housing and Community Development Act of 1974, as amended, which provides that: No person in the United States shall on the ground of race, color, national origin, or sex be excluded from participation in, be denied the benefits of, or be subjected to discrimination under this program or activity which is funded in whole or in part with funds made available under this act.**

24. <u>THE PROVISION OF LOCAL TRAINING, EMPLOYMENT, AND BUSINESS OPPORTUNITIES:</u>

(a) To the greatest extent feasible opportunities for training and employment shall be given by Contractor (and its subcontractors) to lower income residents of the project area, and contracts for work in connection with the project shall to the greatest extent feasible be awarded to business concerns that are located in, or owned in substantial part by persons residing in the area of the project.

(b) The Contractor shall include this section in every subcontract for work in connection with the project.

25. <u>NON SEGREGATED FACILITIES:</u> By entering this Contract, the Contractor certifies that he does not and will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not and will not permit his employees any segregated facilities at any of his establishments, or permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. As used in this paragraph the term "segregated facilities" means any waiting rooms, work areas, rest rooms and washrooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise.

26. <u>JOB OFFICES:</u>

(a) The Contractor and his subcontractors may maintain such office and storage facilities on the site as are necessary for the proper conduct of the work. These shall be located so as to cause no interference to any work to be performed on the site. The Owner shall be consulted with regard to locations.

(b) Upon completion of the improvements, or as directed by the Owner, the Contractors shall remove all such temporary structures and facilities from the site, and leave the site of the work in the condition required by the Contract.

SECTION 01010

SUMMARY OF WORK

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Summary of the Work including work by Owner, Owner furnished products, Work sequence, future Work, Contractor use of Premises, and Owner occupancy.

B. The work covered under this Contract includes all components associated with improvements to the Pirates Beach Wastewater Treatment Plant (WWTP) Replacement. Contractor shall construct and put into operation, as acceptable to Owner, all portions of the work as shown in the Contract Documents. The work includes, but is not limited to structures, equipment, piping, excavation, grading, and roads, as described herein.

C. Contractor shall furnish all labor, supervision, tools and material, as described in the specifications and as shown on the drawings to perform the required work. Provide all appurtenant equipment, connections and special items necessary to accomplish the purposes shown or specified even if such appurtenances are not specifically specified or shown on the drawings. Install all items provided in accordance with the specifications, the manufacturer's recommendations and the best practices of the trades involved.

D. Contractor shall assume full responsibility for the means, methods, techniques, sequences and procedures of construction and safety precautions and programs incidental thereto, and for the functional operation of equipment and systems specified in this Contract. Provide, connect, test and supervise the installation of the equipment and systems specified. The installation and testing of any device, subsystem or system must be performed under the direct supervision of persons qualified by training and experience to capably perform the work in a satisfactory manner.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. The following paragraphs describe the major components of the work to be completed under this Contract. This list shall not to be construed as all-inclusive and shall not waive the Contractor’s responsibility to provide all necessary components of the project, either stated or implied, in full accordance with the drawings and specifications.

B. Work under this contract is for construction of a new Pirates Beach Wastewater Treatment Plant that will replace the existing plant. The existing plant is to reman in service until the completion, startup and acceptance of the new wastewater plant.

Subsequently, the existing plant shall be abandoned in place. A bid alternate item for existing WWTP demolition is included.

C. Headworks

1. A new elevated platform for an external rotary drum screening system
2. A new rotary screening system and associated screenings washer compactor unit (two each)
3. A manual bypass screening system (one each)
4. Two hydraulically induced vortex grit removal units
5. A grit classifier
6. An odor control unit
7. All associated paving, piping, electrical connections and appurtenances required for a complete and functional headworks system

D. Biological Treatment Unit

1. Concrete basins: Mix Box, Aeration Basins, Clarifiers and Sludge Holding Tank
2. Elevated Blower/MCC Building and its appurtenances
3. Aeration system
    a. Blowers
    b. Blower Controls
    c. Blower/aeration Piping
    d. Diffusers
    e. Valves
    f. Flowmeters
    g. Analytical Process Control Instruments
    h. Other Associated Appurtenances
4. Clarifiers
    a. Mechanisms
    b. Bridges
    c. Weirs
    d. Launders
    e. Scum Beach

5. RAS/WAS
    a. Pumps
    b. Piping
    c. Meters
    d. Valves
    e. Other Associated Appurtenances
6. Sludge Holding Tank
    a. Jet Mixing System
    b. Decant System
    c. Other Associated Appurtenances

E. MCC (located in Blower Building)
1. Enclosures
2. Buses
3. Circuit Breakers
4. Starters
5. Control and Timing Relays
6. Wiring
7. Name Plates
8. Surge Protection
9. Other Associated Appurtenances

F. Disinfection System
1. Elevated platform
2. Effluent Filter System
3. UV Disinfection System
4. Cloth Shade System/Structure
5. Other Associated Appurtenances

G. Electrical
1. Underground Power
2. Conduits
3. Wiring
4. Associated Instrumentation and Controls
5. Other Associated Appurtenances

H. SCADA

1. Control system, including computer and/or PLCs
2. Network data communications hardware
3. Graphical user interface
4. Programing
5. Other Associated Appurtenances

I. Odor Control System

1. Drum Scrubber
2. Drum
3. Blower
4. Chemical Media
5. Mist Eliminator/Pre-Filter
6. Controls
7. Other Associated Appurtenances

J. Non-Potable Water System

1. Pumps
2. Piping
3. Other Associated Appurtenances

K. Other Work:

1. New Emergency Generator System.
2. Yard Piping with plant drains and packaged lift station
3. New Plant Paving and Sidewalks
4. Protective Ground Armament
5. Initial Clearing and Grubbing
6. Hydromulch Seeding Disturbed Areas
7. Site Lighting Components
8. Final Grading.
9. All other work depicted in the drawings and required by the specifications to provide a complete and operable wastewater treatment plant.
10. Operator Training
11. Plant Commissioning Start Up and Performance Testing.

1.03 ALTERNATES

A. Alternate bids quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option.

B. Volunteer Alternates, any Alternate not specified in this Section, will not be considered.

C. Accepted Alternates will be identified in the Agreement Between the Owner and Contractor.

D. Bids will be evaluated on base bid price. After determination of lowest bidder, consideration will be given to Alternates and Bid Price adjustments and award will be made on the basis of the most advantageous bid as determined by the City.

E. Description of Bid Alternates:

1. Bid Alternate 1 (BA-1): Provide a screw blower with a permeant magnet motor instead of a conventional electric motor, complete in place.

2. Bid Alternate 2 (BA-2): Decommission the existing Pirates Beach WWTP, which includes draining all tanks, disconnecting all influent piping and disconnecting all discharge piping, complete in place.

3. Bid Alternate 3 (BA-3): Remove all wastewater sludge and associated materials from the Pirates Beach WWTP and properly dispose of these materials per TCEQ regulations including any necessary testing and disposal documentation, complete in place.

4. Bid Alternate 4 (BA-4): Demolish and dispose of the existing Pirated Beach WWTP facilities, including all tankage, above ground piping, structures, the blower building and miscellaneous appearances, and cap all below ground abandoned piping two feet below ground, complete in place.

5. Bid Alternate 5 (BA-5): Provide additional structural concrete in full accordance with the Technical Specifications, as directed by owner, complete in place.

6. Bid Alternate 6 (BA-6): Provide additional select fill in full accordance with the Technical Specifications, as directed by owner, complete in place.

7. Bid Alternate 7 (BA-7): Provide additional 6-inch concrete pavement in full accordance with the Technical Specifications, as directed by owner, complete in place.

8. Bid Alternate 8 (BA-8): Bypass pumping, including all equipment, materials and fuel, complete in place, in full accordance with the Technical Specifications and as directed by the by Owner

1.04 WORK BY OWNER

A. Items noted as Not in Contract (NIC), will be furnished and installed by Owner.

1. N/A

B. Owner will remove and retain possession of the following items prior to start of work:

1. N/A

1.05 OWNER FURNISHED PRODUCTS

A. Products purchased and paid for by Owner:

1. N/A

1.06 WORK SEQUENCE

A. Contractor shall submit a detailed phasing plan for review and approval by the Owner and Engineer prior to the start of construction. The phasing plan shall address the Contractor's proposed method and timing of the major construction activities to be undertaken, such that the Owner and Engineer can readily ascertain the Contractor's intended means and methods, execution sequence and plan feasibility. Contractor shall coordinate the proposed phasing plan with the overall construction schedule, prepared in accordance with the requirements of Section 01325, Construction Schedule.

B. Contractor shall submit proposed construction phasing plan no later than 14 calendar days after Contract award. The Notice to Proceed will not be issued, nor will the Pre-Construction Meeting will not be held, prior to phasing plan approval by the Owner and Engineer.

1.07 FUTURE WORK

A. N/A

1.08 UTILITY OUTAGE AND SHUTDOWN

A. Contractor to obtain Owner's written approval before scheduling or implementing shutdowns or outages.

1.09 OWNER OCCUPANCY

A. The Owner intends to occupy the site for the entirety of the project in order to operate the existing plant. (Provide limits or location of areas of early occupancy, if applicable) portion of the Project by (Provide desired date of occupancy).

B. Cooperate with the Owner to minimize conflict, and to facilitate the Owner's operations. Coordinate Contractor's activities with Owner's Representative.

C. Schedule work to accommodate this requirement.

D. If owner occupies any or all parts of the premises, this action does not signify substantial completion or any limits on the contractor's liability or contractual responsibility of premises.

1.10 GEOTECHNICAL CONDITIONS

A. A recent geotechnical site investigation was completed to provide project design and construction information. Specific site conditions shall not waive the Contractor's responsibility to complete the work stipulated in the drawings and specifications, nor shall it constitute or represent grounds for a claim of changed condition. The geotechnical report shall be made available to the Contractor in conjunction with the technical specification package, and the Contractor shall assume full responsibility for familiarizing himself with the geotechnical conditions and characteristics of the site by all means necessary and available to him, in order to adequately evaluate the cost associated with the completion the work, and shall include all such costs in his bid proposal.

1.11 PRECONSTRUCTION MEETING

A. Prior to the commencement of work at the site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by:

1. Contractor and his superintendent.
2. Principal subcontractors.
3. Representatives of principal suppliers and manufacturers, as appropriate.
4. Engineer or his representative.
5. Owner or his representatives.
6. Governmental representatives, as appropriate.
7. Others as requested by Contractor, the Owner or Engineer.

B. Unless previously submitted to Engineer, Contractor shall bring to the conference a tentative schedule for each of the following:

1. Construction.
2. Cash flow.
3. Procurement.
4. Schedule of Values for progress payment purposes.
5. Shop drawings and other submittals.

C. The purpose of the conference is to designate responsible personnel and establish a working relationship among those parties. Matters requiring coordination will be

discussed and procedures for handling such matters established. The agenda will include:

1. Contractor's tentative schedule and work sequencing plan, including critical items impacting plant operations, such as proposed shut-down periods.
2. Procedures for the transmittal, review and distribution of Contractor's submittals.
3. Processing procedure for monthly payment applications.
4. Procedures for maintaining record documents.
5. Procedures for processing and approval of field decisions and change orders.
6. Use of premises, office and storage areas, security, housekeeping and the City's needs.
7. Major equipment deliveries and priorities.

D. Owner or Engineer will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01015

CONTRACTOR'S USE OF PREMISES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Section includes general use of the site including properties inside and outside of rights-of-way, work affecting road, ramps, streets and driveways and notification to adjacent occupants.

1.02 RIGHTS-OF-WAY

A. Confine access and operations and storage areas to rights-of-way provided by Owner as stipulated in General Conditions of Agreement; trespassing on abutting lands or other lands in the area is not allowed.

B. Contractor may make arrangements, at Contractor's cost, for temporary use of private properties, in which case Contractor and Contractor's surety shall indemnify and hold harmless the Owner against claims or demands arising from such use of properties outside of rights-of-way. Any use of private property shall have a written agreement between the contractor and the property owner. Notify the City in writing of any agreements and provide written agreement with the landowner to the City. The Use of said site shall comply with all City ordinances and restrictions.

C. Restrict total length which materials may be distributed along the route of the construction at any one time to 1,000 linear feet unless otherwise approved by Owner's Representative.

D. To minimize the inconvenience to the public and to maintain better quality control, the total of all demolition, construction and testing activities cannot exceed 2-lanes in one direction (includes parking lane) for a total length of one-thousand (1,000) linear feet or three City Blocks in length, whichever is less.

1.03 PROPERTIES OUTSIDE OF RIGHTS-OF-WAY

A. Altering the condition of properties adjacent to and along rights-of-way will not be permitted unless authorized by the Owner's Representative, Owner and property owner.

B. Ways, means, methods, techniques, sequences, or procedures which will result in damage to properties or improvements in the vicinity outside of rights-of-way will not be permitted.

C. Any damage to properties outside of rights-of-ways shall be repaired or replaced to the satisfaction of the Owner's Representative, Owner and property owner at no cost to the Owner or property owner.

1.04 USE OF SITE

A. Obtain approvals of governing authorities prior to impeding or closing public roads or streets. Do not close more than two consecutive intersections at one time unless approved by the Owner.

B. Notify the Owner's Representative and the Owner a minimum of 72 hours prior to closing a street or a street crossing. Permits for street closures are required in advance and are the responsibility of the Contractor.

C. Maintain access for emergency vehicles including access to fire hydrants.

D. Avoid obstructing drainage ditches or inlets; when obstruction is unavoidable due to requirements of the Work, provide grading and temporary drainage structures to maintain unimpeded flow.

E. Locate and protect private lawn sprinkler systems which may exist on rights-of-ways within the site. Repair or replace damaged systems to condition equal to or better than that existing at start of Work.

F. Perform daily clean up of dirt outside the construction zone, and debris, scrap materials, and other disposable items. Keep streets, driveways, and sidewalks clean of dirt, debris and scrap materials. Do not leave buildings, roads, streets or other construction areas unclean overnight.

1.05 NOTIFICATION TO ADJACENT OCCUPANTS

A. Notify individual occupants in areas to be affected by the Work of the proposed construction and time schedule. Notification shall be not less than 72 hours or more than 2 weeks prior to work being performed within 200 feet, or as specified by the Owner, of the homes or businesses.

B. Include in notification names and telephone numbers of two company representatives for resident contact, who will be available on 24-hour call. Include precautions which will be taken to protect private property and identify potential access or utility inconvenience or disruption.

C. Submit proposed notification to Owner's Representative for approval. Consideration shall be given to the ethnicity of the neighborhood where English is not the dominant language. Notice shall be provided in understandable language when required by Owner.

1.06 PUBLIC, TEMPORARY, AND CONSTRUCTION ROADS AND RAMPS

A. Construct and maintain temporary detours, ramps, and roads to provide for normal public traffic flow when use of public roads or streets is closed by necessities of the Work.

B. Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment or exceptionally large or heavy trucks or equipment.

C. Construct and maintain access roads and parking areas as specified in Section 01500 - Temporary Facilities and Controls.

1.07 EXCAVATION IN STREETS AND DRIVEWAYS

A. Avoid hindering or needlessly inconveniencing public travel on a street or any intersecting alley or street for more than two blocks at any one time, except by permission of the Owner's Representative.

B. Obtain the Owner's Representative and Owner's approval when the nature of the Work requires closing of any portion or an entire street. Permits required for street closure are the Contractor's responsibility. Avoid unnecessary inconvenience to abutting property owners.

C. Remove surplus materials and debris and open each block for public use as work in that block is complete.

D. Acceptance of any portion of the Work will not be based on return of street to public use.

E. Avoid obstructing driveways or entrances to private property.

F. Provide temporary crossing or complete the excavation and backfill in one continuous operation to minimize the duration of obstruction when excavation is required across drives or entrances. Closure of driveways overnight shall not be allowed unless approved by the Owner.

G. Provide barricades and signs in accordance with Section VI of the State of Texas Manual on Uniform Traffic Control Devices latest edition.

1.08 SURFACE RESTORATION

A. Restore site to condition existing before construction to satisfaction of the Owner and Owner's Representative.

B. Repair paved area per the requirements of the plans and specifications.

C. Repair turf areas which become damaged per the requirements of the plans and specifications.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Procedures for measurement and payment plus conditions for nonconformance assessment and nonpayment for rejected products.

1.02 AUTHORITY

A. Measurement methods delineated in Specification sections are intended to complement the criteria of this section. In the event of conflict, the requirements of the Specification section shall govern.

B. Measurements and quantities submitted by the Contractor will be verified by the Owner's Representative.

C. Contractor shall provide necessary equipment, workers, and survey personnel as required by Owner's Representative to verify quantities.

1.03 UNIT QUANTITIES SPECIFIED

A. Quantity and measurement estimates stated in the Agreement are for contract purposes only. Quantities and measurements supplied or placed in the Work and verified by Owner's Representative shall determine payment as stated in the General Conditions.

B. If the actual Work requires greater or lesser quantities than those quantities indicated in the Bid Form, provide the required quantities at the unit prices contracted, except as otherwise stated in the General Conditions.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement by Weight: Measured by unit of weight as submitted on certified load tickets.

B. Measurement by Volume:

1. Stockpiles: Measured by cubic dimension using mean length, width, and height or thickness.

2. Excavation and Embankment Materials: Measured by cubic dimension using cross-sections measured every 100-feet unless otherwise specified by the owner.

C. Measurement by Area: Measured by square dimension using mean length and width or radius.

D. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

E. Stipulated Price Measurement: By unit designated in the agreement.

F. Other: Items measured by weight, volume, area, or lineal means or combination, as appropriate, as a completed item or unit of the Work.

1.05 PAYMENT

A. Payment Includes: Full compensation for all required supervision, labor, products, tools, equipment, plant, transportation, services, and incidentals; and erection, application or installation of an item of the Work; and Contractor's overhead and profit.

B. Total compensation for required Unit Price Work shall be included in Unit Price bid in Bid schedule. Claims for payment as Unit Price Work, but not specifically covered in the list of unit prices contained in Bid Schedule, will not be accepted.

C. No payment for stored material will be made unless stipulated or approved by owner.

D. Progress payments will be based on the Owner’s Representative’s observations and evaluations of quantities incorporated in the Work multiplied by the unit price.

E. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities determined by Owner & Owner’s Representative multiplied by the unit price for Work which is incorporated in or made necessary by the Work.

1.06 NONCONFORMANCE ASSESSMENT

A. Remove and replace the Work, or portions of the Work, not conforming to the Contract Documents.

B. If, in the opinion of Owner & Owner’s Representative, it is not practical to remove and replace the Work, the Owner & Owner’s Representative will direct one of the following remedies:

1. The nonconforming Work will remain as is, but the unit price will be adjusted to a lower price at the discretion of Owner & Owner's Representative.

2. The nonconforming Work will be modified as authorized by the Owner & Owner's Representative, and the unit price will be adjusted to a lower price at the discretion of Owner & Owner's Representative, if the modified work is deemed to be less suitable than originally specified.

C. Specification sections may modify these options or may identify a specific formula or percentage price reduction.

D. The Owner's Representative shall make a recommendation to the City on the assessment of nonconformance and adjustment of payment based on the nonconformance if such condition of nonconformance is not specifically resolved within the contract documents. The Owner will have final approval of the assessment and adjustment of payment."

1.07 NONPAYMENT FOR REJECTED PRODUCTS

A. Payment will not be made for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable to Owner's Representative.

2. Products determined as nonconforming before or after placement.

3. Products not completely unloaded from transporting vehicle.

4. Products placed beyond the lines and levels of the required Work.

5. Products remaining on hand after completion of the Work, unless specified otherwise.

6. Loading, hauling, and disposing of rejected products.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01040

COORDINATION AND MEETINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Section includes general coordination including preconstruction conference, and progress meetings.

1.02 RELATED DOCUMENTS

A. Coordination is required throughout the documents. Refer to all of the Contract Documents and coordinate as necessary.

1.03 ENGINEER AND REPRESENTATIVES

A. The Owner’s Representative may act directly and is identified by name at the preconstruction conference.

1.04 CONTRACTOR COORDINATION

A. Coordinate scheduling, submittals, and Work of the various Specifications sections to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Coordinate completion and clean up of Work for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

C. Coordinate access to site for correction of nonconforming Work to minimize disruption of Owner's activities where Owner is in partial occupancy.

1.05 PRECONSTRUCTION CONFERENCE

A. Owner’s Representative will schedule a preconstruction conference.

B. Attendance Required: Owner’s Representatives, Consultants, Contractor, and major Subcontractors.

C. Agenda:

1. Distribution of Contract Documents

2. Designation of personnel representing the parties in Contract, and the Consultant.

3. Review of insurance

4. Discussion of formats proposed by the Contractor for schedule of values, and construction schedule

5. Procedures and processing of shop drawings and other submittals, substitutions, pay estimates or applications for payment, Requests for Information, Request for Proposal, Change Orders, and Contract closeout

6. Scheduling of the Work and coordination with other contractors

7. Review of Subcontractors and Suppliers

8. Procedures for testing

9. Procedures for maintaining record documents

10. Owner's requirements

11. Construction Schedule

12. Storm Water Pollution Prevention Plan

13. Submittals and TPDES Requirements

14. Use of premises by Owner and Contractor

15. Safety and first aid procedures

16. Construction controls provided by Owner

17. Temporary utilities

18. Survey and layout

19. Security and housekeeping procedures

1.06 PROGRESS MEETINGS

A. Project meetings shall be held at Project field office or other location as designated by the Owner's Representative. Meeting shall be held at monthly intervals, or more frequent intervals if directed by Owner's Representative.

B. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner's representatives, and Consultants as appropriate to agenda topics for each meeting.

C. Owner or his representative will make arrangements for meetings, and recording minutes.

D. Owner or his representative will prepare the agenda and preside at meetings.

E. Contractor shall provide required information and be prepared to discuss each agenda item.

F. Agenda:

1. Review minutes of previous meetings
2. Review of Work progress schedule submittal, and pay estimates, payroll and compliance submittals
3. Field observations, problems, and decisions
4. Identification of problems which impede planned progress
5. Review of submittals schedule and status of submittals
6. Review of Request for Information and Request for Proposal status
7. Change order status
8. Review of off-site fabrication and delivery schedules
9. Maintenance of progress schedule
10. Corrective measures to regain projected schedules
11. Planned progress during succeeding work period
12. Coordination of projected progress
13. Maintenance of quality and work standards
14. Effect of proposed changes on progress schedule and coordination
15. Other items relating to Work

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01045

CUTTING AND PATCHING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cutting, patching and fitting of Work to existing facilities, or to accommodate installation or connection of Work with existing facilities, or to uncover work for access, inspection or testing.

1.02 CUTTING AND PATCHING

A. Perform activities to avoid interference with facility operations and the Work of others in accordance with all provisions and sections of these specifications.

B. Execute cutting and patching, including excavation, backfill and fitting to:

1. Remove and replace defective Work or Work not conforming to the Drawings and Specifications.

2. Take samples of installed Work as required for testing.

3. Remove construction required to provide for specified alteration or addition to existing work.

4. Uncover Work to provide for inspection or reinspection of covered Work by the Owner Representative or regulatory agencies having jurisdiction.

5. Connect any Work that was not accomplished in the proper sequence to completed Work.

6. Remove or relocate existing utilities and pipes which obstruct Work to which connections must be made.

7. Make connections or alterations to existing or new facilities.

8. Provide openings, channels, chases and flues, if any, and do cutting, patching and finishing.

C. Restore existing work to a state equal to or better than that prior to cutting and patching. Restore new Work to standards of these Specifications.

D. Support, anchor, attach, match, trim and seal materials to the Work of others. Unless otherwise specified, furnish and install sleeves, inserts, hangers, required for the execution of the Work.

E. Provide shoring, bracing and support as required to maintain structural integrity and protect adjacent Work from damage during cutting and patching. Before cutting beams or other structural members, anchors, lintels or other supports, request written instructions from the Owner Representative. Follow such instructions, as applicable.

1.03 SUBMITTALS

A. Submit written notice to the Owner Representative requesting consent to proceed prior to cutting which may affect structural integrity or design function, Owner operations, or work of another contractor.

B. Include the following in submittal:

1. Identification of project.

2. Description of affected Work.

3. Necessity for cutting.

4. Effect on other work and on structural integrity.

5. Include description of proposed Work:

a. Scope of cutting and patching.

b. Contractor, subcontractor or trade to execute Work.

c. Products proposed to be used.

d. Extent of refinishing.

e. Schedule of operations.

6. Alternatives to cutting and patching, if any.

C. Should conditions of Work or schedule indicate change of materials or methods, submit a written recommendation to the Owner Representative including:

1. Conditions indicating change.

2. Recommendations for alternative materials or methods.

3. Submittals as required for substitutions.

D. Submit written notice to the Owner Representative designating time Work will be uncovered for observation. Do not begin cutting or patching operations until authorized by the Owner Representative.

1.04 CONNECTIONS TO EXISTING FACILITIES

A. Perform construction necessary to complete connections and tie-ins to existing facilities. Keep all existing facilities in continuous operation unless otherwise specifically permitted in these Specifications or approved by the Owner Representative.

B. To minimize the inconvenience to the public and to maintain better quality control, the total of all demolition, construction and testing activities cannot exceed 2-lanes in one direction (includes parking lane) for a total length of one-thousand (1,000) linear feet or three City Blocks in length, whichever is less. This aforementioned length, shall be completed in its entirety and all services restored including access to driveways, sidewalks and ADA ramps, roads, etc., prior to work commencing on the next section.

C. Coordinate with the Owner Representative, interruption of service requiring connection into existing facilities. Bypassing of wastewater or sludge to waterways is not permitted. Provide temporary pumping facilities to handle wastewater if necessary. Use temporary bulkheads (e.g., inflatable plugs) to minimize disruption. Provide temporary power supply and piping to facilitate construction where necessary.

D. Submit a detailed schedule of proposed connections, including shut-downs and tie-ins. Include in the submittal the proposed time and date as well as the anticipated duration of the Work. Submit the detailed schedule coordinated with the construction schedule.

1. Provide specific time and date information to the Owner Representative 48 hours in advance of proposed Work.

E. Procedures and Operations:

1. Only city personnel shall operate any valve, gate or other item of equipment without authorization of the Owner.

2. Insofar as possible, equipment shall be tested and in operating condition before final tie-ins are made to connect equipment to the existing facility.

3. Carefully coordinate Work and schedules. Provide written notice to the Owner Representative at least 48 hours before shut-downs or by-passes are required.

PART 2 P R O D U C T S - NOT USED.

PART 3 E X E C U T I O N - NOT USED.

END OF SECTION

SECTION 01050

FIELD SURVEYING

PART 1 G E N E R A L

1.01 QUALITY CONTROL

A. Conform to State of Texas laws for surveys requiring licensed surveyors. Employ a Land Surveyor acceptable to Owner Representative, if required by Owner.

1.02 SUBMITTALS

A. Submit to Owner Representative the name, address, and telephone number of Surveyor before starting survey work.

B. Submit documentation verifying accuracy of survey work on request.

1.03 PROJECT RECORD DOCUMENTS

A. Maintain a complete and accurate log of control and survey work as it progresses.

B. Submit Record Documents under provisions of Section 01720 - Project Record Documents.

1.04 EXAMINATION

A. Verify locations of survey control points prior to starting Work. Contractor shall utilize bench mark as basis for field verification of all temporary benchmark elevation prior to commencement of work. Contractor shall provide letter to Owner Representative once he is in agreement with all provided temporary benchmark elevations.

B. Notify Owner Representative immediately of any discrepancies discovered.

1.05 SURVEY REFERENCE POINTS

A. Control datum for survey is that established by Owner-provided survey and indicated on Drawings.

B. Locate and protect survey control points, including property corners, prior to starting site work; preserve permanent reference points during construction.

C. Notify Owner Representative 48 hours in advance of need for relocation of reference points due to changes in grades or other reasons.

D. Report promptly to Owner Representative the loss or destruction of any reference point.

E. Contractor shall reimburse Owner for cost of reestablishment of permanent reference points and temporary benchmarks disturbed by Contractor's operations.

1.06 SURVEY REQUIREMENTS

A. Utilize recognized engineering survey practices.

B. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on Project Record Documents.

C. Establish elevations, lines and levels to provide quantities required for measurement and payment and to provide appropriate controls for the Work. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stakes for grading; fill and topsoil placement; utility locations, slopes, and invert elevations.

2. Grid or axis for structures.

D. Verify periodically layouts by same means.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01060

PRECONSTRUCTION INVESTIGATION BY CONTRACTOR

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Subsurface Utility and Obstruction Evaluation to determine the presence of conflicts so the contractor can perform the conflict resolution in coordination with the City for final approval.

1.2 UNIT PRICES

A. No additional payment will be made for preconstruction investigation by contractor including subsurface utility and obstruction evaluation as well as process undertaken by contractor for obtaining City approval of their proposed conflict resolution plan. Include payment in the unit price for applicable bid items.

B. No separate or additional payment will be made for technologies and equipment used for remote or intrusive work to determine the presence of conflicts from private or public utilities, vegetation or structures, or for damages due to intrusive work that requires restoration by contractor to existing conditions. Include payment in the unit price for applicable bid items.

1.3 DEFINITIONS

Designating: The process of using a surface geophysical method or methods to interpret the presence of a subsurface utility and to mark its approximate horizontal position (its designation) on the ground surface. (Note: Utility owners and contractors sometimes call this process "locating.") Engineer The individual or firm providing engineering and design-related services as a party to the contract. The engineer produces the instruments of service or manages the instruments of service of the subconsultants.
Locating: The process of exposing and recording the precise vertical and horizontal location of a utility.
Minimally intrusive excavation method: A method of excavation that minimizes the potential for damage to the structure being uncovered. Factors such as utility material and condition may influence specific techniques. Typical techniques for utility exposures include air-entrainment/vacuum-extraction systems, water-jet/vacuum-extraction systems, and careful hand tool usage.
One-call notification center: An entity that administers a system through which a person can notify utility owners and operators of proposed excavations. Typically, the one-call center

notifies member utility owners that they may send records to the designer or designate and mark on the ground surface the existing indications of some or all of the utilities that may be present.
One-call statute: A local or state requirement that an excavator or designer of excavation call a central number to notify some or all existing utility owners of that planned excavation.
Subsurface utility evaluation (SUE): Potential obstruction investigation, utility coordination, utility relocation, utility condition assessment, and communication of utility data and approval of all concerned parties.
Surface geophysical method: Any of a number of methods designed to utilize and interpret ambient or applied energy fields for the purpose of identifying properties of, and structure within, the earth. Such methods typically include variants of electromagnetic, magnetic, elastic wave, gravitational, and chemical energies.
Survey datum: The points of reference used by the project owner and engineer to define a specific geographic location in three-dimensional space.
Test hole: The excavation made to determine, measure, and record the presence of a utility structure.
Utility: A privately, publicly, or cooperatively owned line, facility, or system for producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, or any other similar commodity, including any fire or police signal system or street lighting system.
Utility accommodation policy: A policy for accommodating utility facilities on the project. This policy includes, but is not limited to, establishing the horizontal and vertical location requirements and clearances for the various types of utilities; referencing applicable provisions of government or industry codes required by law or regulation; providing standards, specifications, detailed procedures, criteria, and methods of installation; providing requirements for the preservation and restoration of project facilities; setting forth limitations on the utility's activities within the project area; and establishing measures necessary to protect traffic, workers, and the general public during and after the installation of utility facilities.
Utility attribute: A distinctive documented characteristic of a utility that may include but is not limited to elevation, horizontal position, configurations of multiple non-encased pipes or cables, shape, size, material type, condition, age, quality level, and date of measurement.
Utility depiction: A visual image of existing utility information using a computer-aided design and drafting system or on project plan sheets.
Utility quality level: A professional opinion of the quality and reliability of utility information. Such reliability is determined by the means and methods of the professional. Each of the four existing utility data quality levels is established by different methods of data collection and interpretation.
Utility quality level A: Precise horizontal and vertical location of utilities obtained by the actual exposure (or verification of previously exposed and surveyed utilities) and subsequent measurement of subsurface utilities, usually at a specific point. Minimally intrusive excavation equipment is typically used to minimize the potential for utility damage. A precise horizontal and vertical location, as well as other utility attributes, is shown on plan documents. Accuracy is typically set to 15-mm vertical and to applicable horizontal survey and mapping accuracy as defined or expected by the project owner.
Utility quality level B: Information obtained through the application of appropriate surface geophysical methods to determine the existence and approximate horizontal position of subsurface utilities. Quality level B data should be reproducible by surface geophysics at any

point of their depiction. This information is surveyed to applicable tolerances defined by the project and reduced onto plan documents.
Utility quality level C: Information obtained by surveying and plotting visible above-ground utility features and by using professional judgment in correlating this information to quality level D information.
Utility quality level D: Information derived from existing records or oral recollections.
Utility relocation policy: A policy (typically of the project owner or utility owner) for the relocation of utility facilities required by the project. This policy includes, but is not limited to, establishing provisions for compensating utility owners; for removing and reinstalling utility facilities; for acquiring or permitting necessary rights-of-way at the new location; for moving, rearranging, or changing the type of existing facilities; and for taking necessary protective measures.
Utility search: The search for a specific or unknown utility or utilities using a level of effort in accordance with the specified quality level, within a defined area.
Utility trace: The process of using surface geophysical methods to image and track a particular utility.
Utility Records: Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.
Protecting Utilities:

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within the grading limits as designated on the Drawings, and in accordance with requirements of Section 01535 - Tree and Plant Protection.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities are indicated on the Drawings.

3.1 PRE-CONSTRUCTION INVESTIGATION BY CONTRACTOR (**NO SEPARATE PAY**)

A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water mains, gas lines, storm sewers, sanitary sewers, telephone lines, electric lines or power ducts, pipelines (petrochemical or petroleum product), concrete and debris, are based on best information available but are only approximate locations. At critical locations field verify horizontal and vertical

locations of such lines within a zone 2 feet vertically and 4 feet horizontally of proposed main. Verify location of existing utilities prior to commencing construction. Use extreme caution and care when uncovering these lines. Any damage to known on unknown utilities or obstructions occurring during Potential Obstruction Investigation will be full responsibility of Contractor. No separate payment shall be made for performing such efforts.

B. Prior to actual field verification phase, notify all utility companies involved and request that their respective utility lines be marked in field. If any utility or pipeline company requires their line be excavated, or exposed prior to construction, comply with that request and utilize a methodology approved by the said company in locating or exposing their lines. Provide Owner's Representative with 48 hours notice prior to any field excavation or related work.

C. Once known, unknown or potential obstructions have been uncovered, survey vertical and horizontal locations relative to project baseline and datum and plot on 11" X 17" copy of Drawings.

D. Submit 11" X 17" copy of Drawing with plotted utility or obstruction location titled Potential Obstruction Report to Owner's Representative before or simultaneous with pipe shop drawing submittal.

E. Owner's Representative will promptly review Potential Obstruction Report and approve construction of proposed main as designed or modify design if necessary. Contractor will be promptly notified of any design modifications.

F. The accurate location of all utilities, structures, landscaping, irrigation, etc., as shown is approximate and all may not be shown on the plans, quantified on the bid forms, or detailed in the specifications. Contractor is responsible for confirming the material, size, location, quantity, and other details of all objects including pipelines, structures, conduits, cables, surface, subsurface and environmental conditions (ex: water depth, abandoned duct banks, rails, concrete blocks,), etc.

G. The City of Galveston requires the Contractor to pre-locate, pre-verify and pre-investigate all utilities, obstructions and surface and subsurface environmental conditions (shown or not shown) before construction of this project, by whatever method, subject to approval by the owner which includes but is not limited to the following:

1. Utilization of metal detection equipment and probes
2. Excavation, ex: Hydrovac pot holing
3. Opening manholes to determine the flow line of storm pipes and sanitary sewer

4. Measuring the depth to valve nut and adding 18" to determine the depth to waterlines
5. Probing to identify sprinklers, storm system, water/sanitary services, etc.
6. Subsurface Utility Investigation (SUE) Level A through D survey which includes 1 through 5.

H. All investigative work done and all repairs required after investigation shall be accomplished by the contractor.

I. Contractor agrees to be fully responsible for increase in cost, delays in schedule, impact to the public, changes in their construction scope, including any and all damages which might be caused by their failure to exactly locate and preserve all utilities, structures and other obstructions.

J. Contractor shall be responsible for contacting all utility companies through an "811 Call Before You Dig" at least 14 calendar days prior to construction in area of known and unknown utilities which may or may not be shown on the plans.

K. If the contractor requests the City Staff to assist with locating utilities, structures or other surface and below ground features, the City will invoice the contactor fully for such services.

L. Above ground utility information may be obtained by standard land surveying methods. Underground utility locations may be determined by conventional survey methods, newer technologies, or by Subsurface Utility Evaluation (SUE). The SUE process combines surveying and geophysics to accurately identify, characterize, and map underground utilities. To avoid construction issues and delays that create cost overruns, the contractor should AVOID, MITIGATE, or ADJUST for project utility conflicts. Early design and planning phases should include subsurface site characterization of various geologic, environmental, and utility features.

M. Locate existing utilities. This task involves physically locating, marking, and surveying the physical features of utilities. If utility maps are not available, knowledge and survey of the aboveground structure types can indicate the complexity.

N. This task identifies utilities specifically and determines elevations as well as horizontal positions. Examples might include manhole covers, gas pipes, overhead lines, and fiber-optic cables. There are standard location methods and newer technologies used for underground utility locating survey, such as subsurface utility evaluation (SUE), metal detection (MD), ground-penetrating radar (GPR), and electromagnetic line location (EMLL). Topographic surveys may be adequate for project locations with few underground utilities (i.e., in rural areas).

O. Undocumented utilities may have been installed without a record of their location. EMLL or GPR should be used to mark locations on the ground followed by invasive potholing or excavation to determine the utility type. GPR can detect non-metallic targets without tracer wire. SUE is a non-destructive utility investigation to accurately locate, identify, and map underground utilities.

Subtasks.

1. Locate, log, and survey visible features of utilities.
2. To confirm and survey locations of strategic subsurface features, it may be necessary to "pothole" or excavate down to the utility after using MD, GPR, or EMLL.
3. Mark and label locations of subsurface utilities on the ground with stakes, laths, or other means.
4. Survey utility locations.
5. Manhole covers and other obstructions may need to be adjusted for resurfacing projects.

Critical Sequencing.

1. To avoid costly conflicts utility location data needs to be collected before beginning construction.
2. Utility data is needed before establishing final alignments of the roadway and related features (e.g., storm drains, utilities, and other excavation work) to avoid these conflicts and eliminate construction delays or service outage..

Authority.

1. Utilities Code Chapter 251 Underground Facility Damage Prevention and Safety

P. Subsurface Utility Evaluation (SUE). Contractors should be competent and knowledgeable, experienced, insured, timely, and have the equipment and financial capacity to provide the service prior to construction and at no cost to the City (No Separate Pay). Major activities involved in SUE are:

Designating: Surface geophysical techniques to determine the existence and horizontal position of subsurface utilities. Above ground surface markers (stakes, flags, etc.) or on the ground surface marking (paint) mark the location.

Locating: Process of exposing precise horizontal and vertical position, size, and configuration of subsurface utilities.

Data Management: Process of locating, surveying, and designating information and transferring it into project GIS files, plans, or CAD system.

Conflict Analysis: Using a conflict matrix to do an evaluation and compare designating information with proposed plans to inform all stakeholders of potential conflicts, possible resolutions, and costs to resolve.

Quality Level D (QL-D). The most basic level of information. It comes from existing utility records or oral recollections. Its usefulness should be confined to

project planning and route selection activities.

Q. **Quality Level C (QL-C)**. It involves surveying visible aboveground utility facilities, such as manholes, valve boxes, posts, etc., and correlating this information to Quality Level D. Its usefulness should be confined to rural projects where utilities are not prevalent, or are not too expensive to repair or relocate.

R. **Quality Level B (QL-B)**. Using appropriate surface geophysical methods to determine the existence and approximate horizontal position of subsurface utilities. This two-dimensional horizontal mapping information is usually sufficient to accomplish preliminary utility conflict elimination preliminary goals which needs to be further confirmed. Decisions can be made on where to place storm drainage systems and other design features in order to avoid conflicts with existing utilities. Slight adjustments in the design can produce substantial cost savings by eliminating utility relocations.

S. **Quality Level A (QL-A)**. Precise vertical and horizontal location of subsurface utilities obtained by exposure and subsequent measurement, usually at a specific point. Information provides the highest level of accuracy presently available. When surveyed and mapped, precise plan and profile information is available for use in making final design decisions. The use of nondestructive digging equipment, particularly vacuum excavation, eliminates damage to underground utility facilities traditionally caused by backhoes.

END OF SECTION

SECTION 01090

REFERENCE STANDARDS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Section includes general quality assurance as related to Reference Standards and a list of references.

1.02 QUALITY ASSURANCE

A. For Products or workmanship specified by association, trades, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on the date as stated in the General Conditions.

C. Request clarification from Owner's Representative before proceeding should specified reference standards conflict with Contract Documents.

1.03 SCHEDULE OF REFERENCES

AASHTO American Association of State Highway and Transportation Officials

444 North Capitol Street, N.W, Ste. 249

Washington, DC 20001

www.transportation.org

ACI American Concrete Institute

P.O. Box 9094

Farmington Hills, MI 48333-9094

www.concrete.org

AGC	Associated General Contractors of America 2300 Wilson Blvd., Ste. 400 Arlington, VA 22201 www.agc.org
AI	Asphalt Institute 2696 Research Park Drive, P.O. Box 14052 Lexington, KY 40511-8480 www.asphaltinstitute.org
AITC	American Institute of timber Construction 7012 S. Revere Parkway, Suite 140 Centennial, CO 80112 www.aitc-glulam.org
AISC	American Institute of Steel Construction One East Wacker Dr., Ste. 700 Chicago, IL 60601-1802 www.aisc.org
AISI	American Iron and Steel Institute 1140 Connecticut Ave. NW, Ste. 705

Washington, DC 20036

www.aisi.com

ASME American Society of Mechanical Engineers

Three Park Avenue

New York, NY 10016-5990

www.asme.org

ANSI American National Standards Institute

1899 L Street NW, Eleventh Floor

Washington, DC 20036

www.ansi.org

APA American Plywood Association

Box 11700

Tacoma, WA 98411

www.apawood.org

API American Petroleum Institute

1220 L Street, N.W.

Washington, DC 20005

www.api.org

AREMA American Railway Engineering and Maintenance-of-way Association

10003 Derekwood Lane, Ste. 210

Lanham, Maryland 20706

www.arema.org

ASTM American Society for Testing and Materials

100 Barr Harbor Drive

West Conshohocken, PA 19428

www.astm.org

AWPA American Wood-Preservers' Association

P.O. Box 5690

Granbury, TX 76049

www.awpa.com

AWS American Welding Society

550 NW LeJeune Rd.

Miami, FL 33126

www.aws.org

AWWA American Water Works Association

6666 West Quincy Avenue

Denver, CO 80235

www.awwa.org

CLFMI	Chain Link Fence Manufactures Institute 10015 Old Colombia Rd.,Ste. B-215 Columbia, MD 21046 www.clfmi.net
CRSI	Concrete Reinforcing Steel Institute 933 North Plum Grove Road Schaumburg, IL 60173-4758 www.crsi.org
EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591 www.ejma.org
FS	Federal Standardization Documents General Services Administration, Specifications Unit (WFSIS) 7th and D Streets, S.W. Washington, DC 20406 www.gsa.gov
ICEA	Insulated Cable Engineer Association P.O. Box 1568

Carrolton, Ga. 30112

www.icea.net

IEEE Institute of Electrical and Electronics Engineers

445 Hoes Lane

Piscataway, NJ 08854-4141

www.ieee.org

MIL Military Specifications

General Services Administration, Specifications Unit (WFSIS)

7th and D Streets, S.W.

Washington, DC 20406

www.gsa.gov

NACE National Association of Corrosion Engineers

1440 South Creek Drive

Houston, TX 77084-4906

www.nace.org

NEMA National Electrical Manufacturers' Association

1300 North 17th Street, Suite 1752

Rosslyn, VA 22209

www.nema.org

NFPA	National Fire Protection Association 1 Batterymarch Park, P.O. Box 9101 Quincy, MA 02169-7471 www.nfpa.org
OSHA	Occupational Safety Health Administration U.S. Department of Labor, Office of Public Affairs 200 Constitution Ave. Washington, DC 20210 www.osha.gov
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077-1083 www.cement.org
PCI	Prestressed Concrete Institute 200 W. Adams St., Ste. 2100 Chicago, IL 60606 www.pci.org
SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021

www.sdi.org

SSPC Society for Protective Coatings (Steel Structures Painting Council)
40 24th Street, Sixth Floor
Pittsburgh, PA 15222
www.sspc.org

TAC Texas Administrative Code
Texas Water Resources Conservation Commission
P.O. Box 13087
Library MC-196
Austin, TX 78711-3087

TCEQ Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087
www.tceq.state.tx.us

TxDOT Texas Department of Transportation
125 E. 11th Street
Austin, TX 78701-2483
www.txdot.gov

UL	Underwriters' Laboratories, Inc. 2600 N.W. Lake Road Camas, WA. 98607-8542 www.ul.com
UNI-BELL	UNI-BELL Pipe Association 2711 LBJ Freeway, Ste. 1000 Dallas, TX 75234 www.uni-bell.org

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01116

ABBREVIATIONS AND SYMBOLS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

This section includes the definitions for the common technical and organizational abbreviations and acronyms utilized throughout the Project Manual and Drawings.

1.02 TECHNICAL ABBREVIATIONS

alternating current	AC	Hertz	Hz
ante meridiem	a.m.	hour	hr
ampere	A	horsepower	hp
average	avg		
		inch	in
biochemical oxygen demand	BOD	inch-pound	in-lb
brake horsepower	bhp	inside diameter	ID
British thermal unit	Btu		
		kilovolt-ampere	kva
Celsius	C	kilowatt	kw
Company	Co	Kilowatt-hour	kwh
cubic inch	cu in		
cubic foot	cu ft	linear foot	lf
cubic yard	cu yd	liter	l
cubic feet per minute	cfm		
cubic feet per second	cfs	maximum	max
		mercury	Hg
decibel	db	milliampere DC	mAdc
degree, Celsius	20 C	milligram	mg
degree, Fahrenheit	68 F	milligrams per liter	mg/l
diameter	diam	milliliter	ml
direct current	DC	millimeter	mm
dollars	$	million gallon	MG
		million gallons per day minimum	mgd
each	ea	minimum	min
efficiency	eff		
		net positive suction head	npsh
Fahrenheit	F	number	No.
feet	ft	National Pipe Threads	NPT
feet per hour	fph		
feet per minute	fpm	ounce	oz
feet per second	fps	outside diameter	OD
figure	Fig		
flange	flg	parts per million	ppm
foot-pound	ft-lb	plus or minus	(±)
		post meridiem	p.m.
gallon	gal	pound	lb
gallons per minute	gpm	pounds per square foot	psf
gallons per second	gps	pounds per square inch	psi
gram	g	pounds per square inch absolute	psia

pounds per square inch gage	psig	square yard	sq yd
		standard	std
revolutions per minute	rpm	standard cubic feet per minute	scfm
second	sec	total dynamic head	TDH
specific gravity	sp gr	totally-enclosed-fan-cooled	tefc
square	sq	total head	TH
square foot	sq ft		
square inch	sq in	volt	v

1.03 ORGANIZATIONAL ABBREVIATIONS

ACI	American Concrete Institute
ACS	American Chemical Society
AGMA	American Gear Manufacturer's Association
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APHA	American Public Health Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWI	American Woodwork Institute
AWS	American Welding Society
AWWA	American Water Works Association
CRSI	Concrete Reinforcing Steel Institute
DIPRA	Ductile Iron Pipe Research Association
EPA	Environmental Protection Agency
FM	Factory Manual
HEW	Department of Health, Education & Welfare
HUD	Department of Housing & Urban Development
IEEE	Institute of Electrical and Electronic Engineers
IRI	Industrial Risk Insurance
ISA	Instrument Society of America
ISO	Insurance Services Office
JIC	Joint Industrial Council
MSS	Manufacturer's Standardization Society of America
NAAMM	National Association of Architectural Metal Manufacturers
NARUC	National Association of Railroad and Utilities Commissioners
NBHA	National Builders Hardware Association
NCTCOG	North Central Texas Council of Governments
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
PCI	Precast Concrete Institute
SDHPT	Texas State Department of Highways and Public Transportation Commission
SMACNA	Sheet Metal and Air Conditioning National Association

SSPC	Steel Structures Painting Council
TCEQ	Texas Commission on Environmental Quality
TXDOT	Texas Department of Transportation
UL	Underwriters Laboratories, Inc.
USGS	United States Geological Survey
USPHS	United Stated Public Health Service
WEF	Water Environmental Federation
WWEMA	Water and Wastewater Equipment Manufacturers Association

1.04 SYMBOLS

The use of symbols is generally confined to the Drawings; a legend defining all symbols utilized is provided therein.

PART 2 P R O D U C T S – NOT USED

PART 3 E X E C U T I O N – NOT USED

END OF SECTION

SECTION 01292

SCHEDULE OF VALUES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Preparation and submittal of Schedule of Values for stipulated price contracts or for major unit price work on unit price contracts.

1.02 DEFINITION

A. The Schedule of Values is an itemized list that establishes the value of each part of the Work for a stipulated price contract and for major unit price work on a unit price contract. The Schedule of Values is used as the basis for preparing applications for payments. Quantities and unit prices shall be included in the schedule of values.

B. Major Unit Price Work is an individual unit price item:

1. Whose value is greater than five percent of original contract price,

2. Whose value becomes greater than five percent of original contract price as the result of an increase in quantity, or

3. Whose value is $100,000, whichever is least.

1.03 PREPARATION

A. For stipulated price contracts, subdivide the Schedule of Values into logical portions of the Work, such as major work items or work in contiguous construction areas. Use Section 01310 - Construction Schedule to guide the subdivision of work items. The items in the Schedule of Values will correlate directly with the tasks enumerated in the Construction Schedule. Organize each portion using the Table of Contents of this Project Manual as an outline for listing the value of work by Sections. A pro rata share of mobilization, bonds, and insurance may be listed as separate items for each portion of the work.

B. For unit price contracts, items shall use the bid items for the Schedule of Values.

C. For lump sum equipment items, where submittal of operation/maintenance data and testing are required, include a separate item for equipment operation and maintenance data where:

1. Submittal of maintenance data shall be valued at five percent (5%) of the lump sum amount for each equipment item,

2. Submittal for testing and adjusting shall be valued at five percent (5%) of the lump sum amount for each equipment item,

D. Round off figures for each listed item to the nearest $100.00. Set the value of one (1) item, when necessary, to make all values equal the contract price for stipulated price contract or lump sum amount for unit price work.

1.04 SUBMITTAL

A. Submit the Schedule of Values in accordance with the requirements of Section 01300 - Submittals. Submit initial schedule of values within fifteen (15) days after execution of contract or at the time of the pre-construction conference.

B. Revise the Schedule of Values and resubmit for items affected by contract modifications. After the changes are reviewed without exception by the Owner, make the submittal at least 10 days prior to submitting the next application for progress payment.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Submittal procedures for:

1. Schedule of Values
2. Construction Schedules
3. Shop Drawings, Product Data, and Samples
4. Operations and Maintenance Data
5. Manufacturer's Certificates
6. Construction Photographs
7. Project Record Documents
8. Design Mixes
9. Video Tapes or DVD’s
10. And all other submittals the owner deems necessary.

1.02 SUBMITTAL PROCEDURES

A. Scheduling and Handling

1. Schedule submittals well in advance of the need for the material or equipment for construction. Allow time to make delivery of material or equipment after submittal is approved.

2. Develop a submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. The Owner Representative will review and return submittals to the Contractor as expeditiously as possible but the amount of time required for review will vary depending on the complexity and quantity of data submitted. In no case will a submittal schedule be acceptable which allows less than 30 days for initial review by the Owner Representative. This time for review shall in no way be justification for delays or additional compensation to the Contractor.

3. The Owner Representative's review of submittals covers only general conformity to the Drawings, Specifications and dimensions which affect the layout. The Contractor is responsible for quantity determination. No quantities will be verified by the Owner Representative. The Contractor is responsible for any errors, omissions or deviations from the Contract requirements; review of submittals in no way relieves the Contractor from his obligation to furnish required items according to the Drawings and Specifications.

4. Submit 6 copies of documents unless otherwise specified in the following paragraphs or in the Specifications.

5. Revise and resubmit submittals as required. Identify all changes made since previous submittal.

6. The Contractor shall assume the risk for material or equipment which is fabricated or delivered prior to approval. No material or equipment shall be incorporated into the Work or included in periodic progress payments until approval has been obtained in the specified manner.

B. Transmittal Form and Numbering

1. Transmit each submittal to the Owner Representative with a transmittal form.

2. Sequentially number each transmittal form beginning with the number 1. Resubmittals shall use the original number with an alphabetic suffix (i.e., 2A for first resubmittal of Submittal 2 or 15C for third resubmittal of Submittal 15). Each submittal shall only contain one type of work, material, or equipment. Mixed submittals will not be accepted.

3. Identify variations from requirements of Contract Documents and identify product or system limitations.

4. For submittal numbering of video tapes or DVD's, coordinate with the Owner Representative.

C. Contractor's Certification

1. Each submittal shall contain a statement or stamp signed and dated by the Contractor, certifying that the items have been reviewed in detail and are correct and in accordance with Contract Documents, except as noted by any requested variance.

1.03 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

A. Shop Drawings

1. Submit shop drawings for review as required by the Specifications.

2. Contractor's Certification, as described in paragraph 1.02C, shall be placed on each drawing.

3. The drawings shall accurately and distinctly present the following:

   a. Field and erection dimensions clearly identified as such

   b. Arrangement and section views

   c. Relation to adjacent materials or structure including complete information for making connections between work under this Contract and work under other contracts

   d. Kinds of materials and finishes

   e. Parts list and descriptions

   f. Assembly drawings of equipment components and accessories showing their respective positions and relationships to the complete equipment package

   g. Where necessary for clarity, identify details by reference to drawing sheet and detail numbers, schedule or room numbers as shown on the Contract Drawings.

4. Drawings shall be to scale, and shall be a true representation of the specific equipment or item to be furnished.

B. Product Data

1. Submit product data for review as required in Specification sections.

2. Contractor's Certification, as described in paragraph 1.02C, shall be placed on each data item submitted.

3. Mark each copy to identify applicable products, models, options to be used in this Project. Supplement manufacturers' standard data to provide information unique to this Project, where required by the Specifications.

4. For products specified only by reference standard, give manufacturers, trade name, model or catalog designation and applicable reference standard.

5. For products proposed as alternates to "approved" products, as described in Section 01630 - Product Options and Substitutions, provide all information

required to demonstrate the proposed products meet the level of quality and performance criteria of the "approved product".

C. Samples

1. Submit samples for review as required by the Specifications.

2. Contractor's Certification, as described in paragraph 1.02C, shall be placed on each sample or a firmly attached sheet of paper.

3. Submit the number of samples specified in Specifications; one of which will be retained by the Owner's Representative.

4. Reviewed samples which may be used in the Work are identified in Specifications.

1.04 MANUFACTURER'S CERTIFICATES

A. When specified in Specification sections, submit manufacturers' certificate of compliance for review by Owner's Representative.

B. Contractor's Certification, as described in paragraph 1.02C, shall be placed on front page of the certificate.

C. Submit supporting reference data, affidavits, and certifications as appropriate.

D. Certificates may be recent or previous test results on material or product, but must be acceptable to Owner's Representative.

1.05 DESIGN MIXES

A. When specified in Specifications, submit design mixes for review.

B. Contractor's Certification as described in paragraph 1.02C, shall be placed on front page of each design mix.

C. Mark each design mix to identify proportions, gradations, and additives for each class and type of design mix submitted. Include applicable test results on samples for each mix.

D. Maintain a copy of approved design mixes at mixing plant.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULE

PART 1 G E N E R A L

1.01 DESCRIPTION

A. Furnish projected construction schedule for entire work.

B. Revise monthly.

1.02 FORM OF SCHEDULE

A. Prepare by bar chart method.

B. Arrange by chronological order by beginning of each item of work.

1.03 CONTENT OF SCHEDULES

A. Include complete sequence of construction by activity:

1. Shop drawings, product data and samples: Submittal dates and dates reviewed copies will be required.

2. Decision dates.

3. Product procurement and delivery dates.

4. Dates for beginning, and completion of each element of construction.

5. Tentative dates for progress meetings.

6. To minimize the inconvenience to the public and to maintain better quality control, the total of all demolition, construction and testing activities cannot

exceed 2-lanes in one direction (includes parking lane) for a total length of one-thousand (1,000) linear feet or three City Blocks in length, whichever is less.

B. Show projected percentage of completion for each item of work as of first day of each month.

C. Furnish subschedules to define critical portions of entire schedule.

D. Show anticipated payment to complete work.

E. Anticipated completion date and one year post acceptance inspection date.

1.04 UPDATING

A. Show all changes occurring since previous month's submission of updated schedule.

B. Indicate progress of each activity.

C. Show completion dates.

D. If in opinion of the Owner, Contractor falls behind in scheduled progress, Contractor shall take steps required to regain lost progress without additional cost to Owner, and likewise revise schedule accordingly.

1.05 SUBMITTALS

A. Submit initial schedules within fifteen days after execution of Contract or at the time of the Pre-Construction conference.

B. Owner’s Representative will review schedules and return review copy within ten days after receipt.

C. If required, resubmit within seven days after return of review copy.

D. Submit periodically updated schedules accurately depicting progress to first day of each month.

E. Submit number of copies required by Contractor plus four copies to be retained by Owner’s Representative.

1.06 DISTRIBUTION

A. Distribute copies of reviewed schedules to:

1. Owner’s Representative.

2. Job-site file.

3. Subcontractors.

4. Owner.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01340

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

This section includes the requirements for the provision of submittals related to shop drawings, product data and samples.

1.02 SHOP DRAWINGS

A. Provide professionally-prepared and/or drafted shop drawings for review, as required.

B. Reference project specification or drawing numbers, if necessary to clarify shop drawing submittal information.

C. Clearly indicate all field dimensions.

D. The use of construction drawing reproductions by Contractor, sub-contractor(s), erector, fabricator, or material supplier, in lieu of shop drawing preparation is permitted; however, it will signify such party's acceptance of all information shown therein as correct, and obligates him to any job expense, real or implied, arising due to any errors that may occur thereon. In addition, all references to the Architect or Engineer, including all professional seals, are to be removed from the drawing prior to its being submitted as a shop drawing.

1.03 PRODUCT DATA

A. Provide manufacturer-supplied product data for review, as required.

B. For manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other descriptive data:

1. Clearly mark to identify materials, products or models being submitted for review.
2. Show dimensions and clearances required.
3. Show performance characteristics and capacities.
4. Show wiring diagrams and controls.
5. Provide additional supplemental information if required for clarity.

1.04 SAMPLES

In general, submission of samples shall not be required. If specifically requested by Owner, submit samples of sufficient size and quantity to clearly illustrate functional characteristics of product or materials, including integrally related parts and attachment devices, and full range of available colors.

PART 2 P R O D U C T S

Products which require shop drawings, product data and samples are indicated in the individual technical specification sections.

PART 3 E X E C U T I O N – NOT USED

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Photographic requirements for construction photographs and submittals

1.02 UNIT PRICES

A. No separate payment will be made for work under this section. Include the cost in the unit price of related work.

1.03 SUBMITTALS

A. Construction Photographs shall be made and submitted according to the provisions of all sections of these specifications.

B. All photographs shall be taken digitally and submitted on a CD-ROM with Project Name, Contractor and Date Photographs were taken.

C. Prepare 2 copies of the CD-ROM's of each view in digital format and submit 1 directly to the Owner's Representative within 5 days of taking photographs.

PART 2 P R O D U C T S

2.01 PRECONSTRUCTION PHOTOGRAPHS

A. Prior to the commencement of any construction, take digital color photographs of the entire route of the project. Photographs shall be 5 megapixel or better quality.

B. Provide photographs recorded on a CD-ROM and a photo log shall be submitted with the CD's providing the required details.

C. The photographs shall show:

1. Date photographs were taken

2. Location of the photograph, house number and street name.

This information may be shown on a chalkboard in the photograph or by a label on the photo log.

D. Photographs should show the condition of the following:

1. Esplanades and boulevards
2. Yards (near side and far side of street)
3. House walk, sidewalk and driveway.
4. Curb.
5. Area between walk and curb.
6. Surface features (yard lights, fences, manholes, valve boxes, sprinkler heads, mail boxes, etc.)
7. Trees, shrubs and grass.
8. Any other items the contractor, Owner, and/or Owner's Representative requests or requires.
9. Areas of damaged improvements that the Contractor desires to document preconstruction.

2.02 POST CONSTRUCTION PHOTOGRAPHS

A. On completion of construction, provide photographs of any public or private property which has been repaired or restored and any damage which is the subject of complaints. Damaged areas that cannot be documented by photographs preconstruction will be the Contractor's responsibility for repair.

B. Submit in same quantity and format as the preconstruction photographs.

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01410

TESTING LABORATORY SERVICES

1.0 GENERAL

1.1 CONDITIONS

A. Testing, inspection, and control of materials required by these specifications shall be performed by a commercial testing laboratory meeting the specified requirements.

B. Owner will select and pay for services of commercial testing laboratory to perform density tests for field control and to perform the various laboratory testing services necessary for field control of the work as specified in respective specification sections, except Contractor shall pay for services of commercial testing laboratory approved by Owner to perform the following:

1. Pipe diameter deflection tests on all flexible and semi-rigid sanitary sewer collection system pipe installation.

2. Testing of systems or partially completed systems, such as testing of water and sewer systems, water supply and drainage systems, air systems, electrical systems and grounding systems.

3. Laboratory services required to establish mix design proposed for use for Portland cement concrete, asphaltic concrete mixtures, and other material mixes requiring control by testing laboratory.

4. Analysis of aggregates, fixing gradations, and the preparation and testing of design cylinders, beams, or specimens, and other services required to establish design or redesign of material mixes requiring control by testing laboratory when required because of change in source of materials or other conditions not caused by Owner.

5. Tests required to establish optimum moisture of earth and base materials and to determine required compactive effort to meet density requirements (Contractor shall pay for all proctor curves to establish optimum moisture and Owner shall pay for all density tests).

6. Cores to test for thickness of paving that are performed at Contractor’s election.

7. Testing and inspection performed for the Contractor's convenience.

8. Retesting and repetitions of laboratory services when initial tests indicate work does not comply with requirements of Contract Documents.

C. Specified testing frequencies are recommended standards, and may be increased or decreased by the Owner or Owner's Representative as deemed necessary for quality control of materials and the work.

D. Reports and commentaries by testing laboratory shall in no way relieve Contractor of his obligation to perform work in full compliance with standards and provisions of the Contract Documents.

E. The Contractor shall not be relieved of his obligation to perform work in full compliance with the standards and provisions of the Contract Documents by reason of the Owner's performance in testing or refraining from testing the work.

F. Owner reserves right to take samples and specimens, and conduct tests on material and work provided by Contractor to assure quality control.

1.2 REQUIREMENTS OF LABORATORY

A. Meet basic requirements of ASTM E329, latest edition.

B. Testing Equipment: Calibrated at maximum twelve month intervals by devises of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

C. Testing laboratory is only required to have testing facilities for work included in this project.

D. Submit copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during most recent tour of inspection.

E. Submit memorandum of remedies of any deficiencies reported by inspection.

1.3 LABORATORY DUTIES AND LIMITATIONS OF AUTHORITY

A. Cooperate with Owner's Representative, Owner and Contractor.

1. Unless directed by Owner or Owner's Representative, types and frequencies of tests as specified in specifications sections for field quality control shall not be exceeded.

2. Owner may not accept charges for tests in excess of types and frequencies specified in specifications sections unless authorized by the Owner's Representative or Owner.

3. Charges for tests to be paid for by Owner shall be submitted promptly to Owner's Representative to allow adequate time for his review before time for payment by Owner.

4. Unless otherwise directed or stipulated, samples, specimens, and field test locations shall be selected under the control of the Owner's Representative.

B. Provide qualified personnel promptly on notice.

C. Perform required inspections, sampling, and testing of materials and methods of construction, including making and curing concrete test specimens.

D. Ascertain Contractor's compliance with specifically named standards of the Contract Documents.

E. Comply with specified testing and sampling standards, or recognized authoritative testing and sampling standards when none are specifically named in the Specifications.

F. Immediately notify Owner's Representative, Owner and Contractor of irregularities or deficiencies of work which are observed during performance of services. Immediately is defined as the same day that the irregularity or deficiency is determined and shall be in person, by telephone or by e-mail.

G. Promptly distribute copies of reports of inspections and tests:

1. Owner: One copy.

2. Owner's Representative: One copy.

3. Contractor: Two copies.

H. Perform additional services as required by Owner.

I. Laboratory is not authorized to:

1. Revoke, alter, enlarge on, or waive requirements of Contract Documents.

2. Approve or accept any portion of work.

3. Reject or stop work, but only shall notify Owner's Representative or his representative of any failure, deficiencies, or irregularities immediately.

4. Perform any duties of Contractor.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Before starting to use proposed design mix and mix materials in construction, arrange for testing of design mixes and mix materials for Portland cement concrete, asphaltic concrete, and other material mixes requiring control by testing laboratory.

B. Cooperate with laboratory personnel, provide access to work, and to construction and fabrication operations.

C. Provide samples of materials to be tested in required quantities.

D. Provide adequate on-site storage area for testing laboratory.

E. Furnish copies of mill test reports for the materials being used on the job when requested by Owner's Representative.

1. Mill certificates will be acceptable when it is definite that certified mill test sheets apply to the material being supplied.

F. Furnish labor to provide access to work to be tested, to obtain and handle samples at site, and to facilitate inspections and tests.

G. Notify laboratory and Owner's Representative 48 hrs. minimum in advance of operations requiring control by testing laboratory, to allow for assignment of personnel and scheduling of tests.

H. Contractor shall notify the Laboratory and Owner's Representative immediately upon discovery of conditions or circumstances requiring cancellation of work.

I. Arrange with laboratory and pay for:

1. Retesting required for failed tests.

2. Retesting for nonconforming Work.

3. Additional sampling and tests requested by Contractor beyond specified requirements.

4. Insufficient notification of cancellation of tests for work scheduled but not performed.

1.5 SPECIFIC TESTS, INSPECTIONS AND METHODS REQUIRED

A. Certification of Products: As required by respective specification sections.

B. Test, Adjust and Balance of Equipment: As required by respective specification sections.

C. Sampling and Laboratory Tests: As required by respective specification sections.

END OF SECTION

SECTION 01420

CONSTRUCTION INSPECTION SERVICES

1.0 GENERAL

1.1 SECTION INCLUDES

A. Inspection services and references

1.2 CONDITIONS

A. Owner reserves right to observe and inspect samples and specimens to be tested, and observe tests on material and work provided by Contractor to assure quality control.

B. Inspection level of service may be increased or decreased by the Owner or Owner's Representative as deemed necessary for quality control of materials and work.

C. Owner's Representative will appoint an Inspector as a representative of the Owner. Alternately, Owner's Representative may appoint, employ, and pay an independent firm to provide and/or supplement inspection services.

D. Reports and commentaries by Inspector shall in no way relieve Contractor of his obligation to perform work in full compliance with standards and provisions of the Contract Documents.

E. The Contractor shall not be relieved of his obligation to perform work in full compliance with the standards and provisions of the Contract Documents by reason of the Owner's performance in inspection or refraining from inspecting the work.

F. The Contractor shall not be relieved of his obligation to perform the work safely and with all safety requirements by reason of the owner's performance of inspection or refraining from inspections of the work.

1.3 INSPECTORS DUTIES AND LIMITATIONS OF AUTHORITY

A. Perform inspections, observe tests, and provide other services specified in individual Technical Specifications.

B. Ascertain Contractor's compliance with specifically named standards of the Contract Documents.

C. Produce reports to be submitted to Owner, Owner's Representative, and Contractor, indicating observations and compliance or non-compliance with Contract Documents and quantities installed.

D. Perform additional services as required by Owner.

E. Inspector is not authorized, without approval of Owner's Representative, to:
   1. Revoke, alter, enlarge, or waive requirements of the Contract Documents.
   2. Approve or accept any portion of work.
   3. Perform any duties of Contractor.

F. Inspector has the authority to stop work when work is being performed in an unsafe manner or if other issues arise that he deems necessitate stopping work.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Inspector, provide access to work and to construction and fabrication operations.

B. Furnish copies of mill test reports for the materials being used on the job when requested by Owner's Representative or Inspector.
   1. Mill certificates will be acceptable when it is definite that certified mill test sheets apply to the material being supplied.

C. Furnish labor to provide access to work to be inspected, to obtain and handle samples at site, and to facilitate inspections and tests.

D. Contractor shall sign and acknowledge reports for Inspector.

E. Notify Owner's Representative 24 hrs. prior to expected time for operations requiring services. Notify independent firm when noted.

F. Arrange with Inspector and pay for:
   1. Re-inspecting nonconforming Work.
   2. Insufficient notification of cancelation of work scheduled but not performed if such work required increase inspection services.
   3. Inspection services for work on weekends, City Holidays and after hours that has been approved at the request of the contractor.

END OF SECTION

SECTION 01430

CONTRACTOR'S QUALITY CONTROL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Quality assurance and control of installation and manufacturer's field services and reports.

1.02 SUBMITTALS

A. Make Submittals required by this section and in accordance with all provisions of these specifications.

1.03 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce the Work of specified quality at no additional cost to the Owner.

B. Comply fully with manufacturers' installation instructions, including each step in sequence.

C. Request clarification from the Owner's Representative before proceeding should manufacturers' instructions conflict with Contract Documents.

D. Comply with specified Standards as a minimum requirement for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce the specified level of workmanship.

F. Obtain copies of Standards and maintain at Project Site when required by individual Technical Specifications.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Technical Specifications, provide material or product suppliers' or manufacturers' technical representative to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, operator training, test, adjust, and balance of equipment as applicable, and to initiate operation, as required. Conform to minimum time requirements for start-up operations and operator training if defined in Technical Specifications.

B. At the Owner's Representative's request, submit qualifications of manufacturer's representative to Owner's Representative fifteen (15) days in advance of required representative's services. The representative shall be subject to approval of Owner's Representative.

C. Manufacturer's representative shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions. Submit report within one (1) day of observation to Owner's Representative for review.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Temporary facilities and the necessary controls for the project including utilities, telephone, sanitary facilities, field office, storage sheds and building, safety requirements, first aid equipment, fire protection, security measures, protection of the Work and property, access roads and parking, environmental controls, disposal of trash, debris, and excavated material, pest and rodent control, water runoff and erosion control.

1.02 UNIT PRICES

A. No separate payment for work under this section. Include the costs for performing the work in project costs.

1.03 CONTRACTOR'S RESPONSIBILITY

A. The facilities and controls specified in this section are considered minimum for the Project. The Contractor may provide additional facilities and controls for the proper execution of the Work and to meet Contractor's responsibilities for protection of persons and property.

B. Comply with applicable requirements specified in other sections of the Specifications.

1. Maintain and operate temporary facilities and systems to assure continuous service.

2. Modify and extend systems as Work progress requires.

3. Completely remove temporary materials and equipment when their use is no longer required.

4. Restore existing facilities used for temporary services to specified or original condition.

1.04 TEMPORARY UTILITIES

A. Obtaining Temporary Service.

1. Make arrangements with utility service companies for temporary services.

2. Abide by rules and regulations of the utility service companies or authorities having jurisdiction.

3. Be responsible for utility service costs until the Work is substantially complete. Included are fuel, power, light, heat, and other utility services necessary for execution, completion, testing, and initial operation of the Work.

B. Water

1. Provide water required for and in connection with Work to be performed and for specified tests of piping, equipment, devices, or for other use as required for proper completion of the Work.

2. Contractor shall not operate any fire hydrants without first having a meter from the City of Galveston and having placed this meter on the hydrant. The Contractor shall operate fire hydrant(s) only with an approved hydrant wrench.

3. Provide and maintain an adequate supply of potable water for domestic consumption by Contractor personnel.

C. Electricity and Lighting.

1. Provide electric power service as required for the Work, including testing of Work. Provide power for lighting, operation of the Contractor's equipment, or for any other use by Contractor.

2. Electric power service includes temporary power service or generator to maintain plant operations during any scheduled shutdown.

3. Minimum lighting level shall be 5 foot-candles for open areas; 10-foot-candles for stairs and shops.

D. Temporary Heat and Ventilation

1. Provide temporary heat as necessary for protection or completion of the Work.

2. Provide temporary heat and ventilation to assure safe working conditions; maintain enclosed areas at a minimum of 50°F.

E. Telephone

1. Provide emergency telephone service at the Contractor's field office, or by mobile telephone, for use by Contractor personnel and others performing work or furnishing services at the site.

F. Sanitary Facilities

1. Provide and maintain sanitary facilities for persons on the job site; comply with the regulations of State and local departments of health.

2. Enforce the use of sanitary facilities by construction personnel at the job site. Such facilities shall be enclosed. Pit-type toilets will not be permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause a nuisance or health problem; have sewage and waste hauled off-site and properly disposed in accordance with local regulations.

3. Locate toilets near the Work site and secluded from view insofar as possible. Keep toilets clean and supplied throughout the course of the Work.

1.05 FIELD OFFICE

A. Provision of a field office is not required unless specified in the conditions of this contract. If the Contractor chooses to provide one, locate it in a place approved by the Owner Representative.

1.06 STORAGE OF MATERIALS

A. Provide adequately ventilated, watertight storage facilities with floor above ground level for materials and equipment susceptible to weather damage.

B. Storage of materials not susceptible to weather damage may be on blocks off the ground.

C. Store materials in a neat and orderly manner. Place materials and equipment to permit easy access for identification, inspection and inventory.

D. Contractor is responsible for materials and equipment stored on and off site.

1.07 SAFETY REQUIREMENTS

A. Submit and follow a safety program. Include in the safety program documented response to trench safety requirements as specified in Section 01526 - Trench Safety System.

B. Conduct operations in strict accord with applicable Federal, State and local safety codes and statutes and with good construction practice. The Contractor is fully responsible and obligated to establish and maintain procedures for safety of all work, personnel and equipment involved in the Project.

C. Observe and comply with Texas Occupational Safety Act (Art. 5182a, V.C.S.) and with all safety and health standards promulgated by Secretary of Labor under Section 107 of Contract Work Hours and Standards Act, published in 29 CFR Part 1926 and adopted by Secretary of Labor as occupational safety and health standards under the Williams-Steiger Occupational Safety and Health Act of 1970, and to any other legislation enacted for safety and health of Contractor employees. Such safety and health standards apply to subcontractors and their employees as well as to the Contractor and its employees.

D. Observance of and compliance with the regulations shall be solely and without qualification the responsibility of the Contractor without reliance or superintendence of

or direction by the Owner Representative. Immediately advise the Owner Representative of investigation or inspection by Federal Safety and Health inspectors of the Contractor or subcontractor's work or place of work on the job site under this Contract, and after such investigation or inspection, advise the Owner Representative of the results. Submit one copy of accident reports to Owner Representative within 10 business days of occurrence.

E. Protect areas occupied by workmen using the best available devices for detection of lethal and combustible gases. Test such devices frequently to assure their functional capability. Constantly observe infiltration of liquids into the Work area for visual or odor evidences of contamination, immediate take appropriate steps to seal off entry of contaminated liquids to the Work area.

F. Safety measures, including but not limited to safety personnel, first-aid equipment, ventilating equipment and safety equipment, in the specifications and shown on the Drawings are obligations of the Contractor.

G. Maintain required coordination with the local Police and Fire Departments during the entire period covered by the Contract.

H. Include project safety analysis in safety plan. Itemize major tasks and potential safe hazards. Plan to eliminate hazards or protect workers and public from each hazard.

1.08 FIRST AID EQUIPMENT

A. Provide a first aid kit throughout the construction period. List telephone numbers for physicians, hospitals, and ambulance services in each first aid kit.

B. Have at least one person thoroughly trained in first aid procedures present on the site whenever Work is in progress. Contractor to conform to protocols and requirements for training and protection against “blood borne pathogens.”

1.09 FIRE PROTECTION

A. Fire Protection Standards.

1. Conform to specified fire protection and prevention requirements as well as those which may be established by Federal, State, or local governmental agencies.

2. Comply with all applicable provisions of NFPA Standard No. 241, Safeguarding Building Construction and Demolition Operations.

3. Provide portable fire extinguishers, rated not less than 2A or 5B in accordance with NFPA Standard No. 10, Portable Fire Extinguishers, for each temporary building, and for every 3000 square feet of floor area of facilities under construction.

4. Locate portable fire extinguishers within 50 feet maximum from any point in the Project area in which work is performed.

B. Fire Prevention and Safety Measures.

1. Prohibit smoking in hazardous areas. Post suitable warning signs in areas which are continuously or intermittently hazardous.

2. Use metal safety containers for storage and handling of flammable and combustible liquids.

3. Do not store flammable or combustible liquids in or near stairways or exits.

4. Maintain clear exits from all points within a structure.

1.10 SECURITY MEASURES

A. Protect all Work materials, equipment, and property from loss, theft, damage, and vandalism. Contractor's duty to protect property includes Owner's property.

B. If existing fencing or barriers are breached or removed for purposes of construction. Provide and maintain temporary security fencing equal to existing.

1.11 PROTECTION OF PUBLIC UTILITIES

A. Prevent damage to existing public utilities during construction. These utilities are shown on the Drawings at their approximate locations, but all lines may not be shown. Pre-locate, by whatever means may be required (metal detection equipment, probes, excavation, survey), all underground utilities before excavating in area. All investigative work will be done and all repairs required after investigation will be accomplished by Contractor. Contractor is responsible for damages caused by failure to locate and preserve these underground utilities. Give owners of these utilities at least 48 hours notice before commencing Work in area, for locating utilities during construction and allow adequate time for making adjustments or relocation of the utilities when they conflict with proposed Work. Any temporary relocation of utilities if necessary to accommodate construction will not be paid for separately. Bypassing of sanitary waste to storm drainage facilities is not allowed. Utility service lines are not shown on Drawings. Anticipate that such service lines exist and repair them if damaged due to any construction activity. No separate payment will be made for this repair work.

B. Prior to abandonment of utility, make appropriate arrangements with City and owner of utility to terminate service, remove meters, transformers, and poles as may be required by site conditions.

C. When excavating near pipelines and prior to start of excavation, request a representative of pipeline company to come to construction site(s) to meet representatives of Contractor and Owner Representative to discuss actual procedures that will be used. Request

pipeline company's representative to probe and locate the pipelines in at least three locations: one at each side of proposed excavation and one at centerline of proposed utility. The Contractor may be required to locate the pipeline as directed by the pipeline company at no cost to the project. Representative of pipeline company and Owner Representative must be present to observe activities of Contractor at all times when excavation is being conducted within 15 feet of pipeline company's pipeline.

1.12 PROTECTION OF THE WORK AND PROPERTY

A. Preventive Actions.

1. Take precautions, provide programs, and take actions necessary to protect the Work and public and private property from damage.

2. Take action to prevent damage, injury or loss, including, but not limited to, the following:

a. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with progress of the Work or the Work of any other contractor, any utility service company, or the Owner's operations.

b. Provide suitable storage for materials which are subject to damage by exposure to weather, theft, breakage, or otherwise.

c. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.

d. Frequently clean up refuse, rubbish, scrap materials, and debris caused by construction operations, keeping the Project site safe and orderly.

e. Provide safe barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways, and other hazardous areas.

3. Obtain written consent from proper parties before entering or occupying with workers, tools, materials or equipment, privately-owned land except on easements provided for construction.

4. Assume full responsibility for the preservation of public and private property on or adjacent to the site. If any direct or indirect damage is done by or on account of any act, omission, neglect, or misconduct in execution of the Work by the Contractor, it shall be restored by the Contractor to a condition equal to or better than that existing before the damage was done.

B. Barricades and Warning Signals.

1. Where work is performed on or adjacent to any roadway, right-of-way, or public place; furnish and erect barricades, fences, lights, warning signs, and danger signals; provide watchmen; and take other precautionary measures for the protection of persons or property and protection of the Work. Barricades shall be painted to be visible at night. From sunset to sunrise, furnish and maintain at least one light at each barricade. Erect sufficient barricades to keep vehicles from being driven and pedestrians from walking on or into Work under construction. Furnish watchmen in sufficient numbers to protect the Work. Responsibility of maintenance of barricades, signs, lights and for providing watchmen shall continue until the Project is accepted by the Owner. Comply with Section -1570 – Traffic Control and Regulation

C. Tree and Plant Protection. Comply with requirements of Section 01535 – Tree and Plant Protection.

D. Protection of Existing Structures

1. Underground Structures:

a. Underground structures are defined to include, but not be limited to, sewer, water, gas, and other piping, and manholes, chambers, electrical and signal conduits, tunnels, and other existing subsurface installations located within or adjacent to the limits of the Work.

b. Known underground structures, including water, sewer, electric, and telephone services are shown on the Drawings in accordance with the best information available, but are not guaranteed to be correct or complete.

c. Explore ahead of trenching and excavation work and uncover obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption of utility services. Restore to original condition damages to underground structure at no additional cost to the Owner.

d. Necessary changes in location of the Work may be made by the Owner Representative to avoid unanticipated underground structures.

e. If permanent relocation of an underground structure or other subsurface installations is required and not otherwise provided for in the Contract Documents, the Owner Representative will direct Contractor in writing to perform the Work, which shall be paid for under the provisions for changes in the Contract Price as described in the General Conditions.

2. Surface Structures:

a. Surface structures are defined as existing buildings, structures and other constructed installations above the ground surface. Included with such

structures are their foundations or any extension below the surface. Surface structures include, but are not limited to buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks, guard cables, fencing, and other facilities that are visible above the ground surface.

3. Protection of Underground and Surface Structures:

   a. Support in place and protect from direct or indirect injury to underground and surface structures located within or adjacent to the limits of the Work. Install such supports carefully and as required by the party owning or controlling such structure. Before installing structure supports, Contractor shall satisfy the Owner Representative that the methods and procedures to be used have been approved by the owner of the structure.

   b. Avoid moving or in any way changing the property of public utilities or private service corporations without prior written consent of a responsible official of that service or public utility. Representatives of these utilities reserve the right to enter within the limits of this project for the purpose of maintaining their properties, or of making such changes or repairs to their property that may be considered necessary by performance of this Contract.

   c. Notify the owners and/or operators of utilities and pipelines of the nature of construction operations to be performed and the date or dates on which those operations will be performed. When construction operations are required in the immediate vicinity of existing structures, pipelines, or utilities, give a minimum of 5 working days advance notice. Probe and flag the location of underground utilities prior to commencement of excavation. Keep flags in place until construction operation reach and uncover the utility.

   d. Assume risks attending the presence or proximity of underground and surface structures within or adjacent to the limits to the Work including but not limited to damage and expense for direct or indirect injury caused by the Work to any structure. Immediately repair damage caused, to the satisfaction of the owner of the damaged structure.

E. Employ a structural engineer to ensure protection measures are adequate for the safety and integrity of structures and facilities.

F. Protection of Installed Products.

1. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of Work.

2. Control traffic to prevent damage to equipment, materials, and surfaces.

1.13 ROADS AND PARKING

A. Prevent interference with traffic and Owner operations on existing roads.

B. Designate temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking. Locate as approved by Owner.

C. Minimize use by construction traffic of existing residential streets and driveways.

D. Do not allow heavy vehicles or construction equipment in existing parking areas.

1.14 ENVIRONMENTAL CONTROLS

A. Provide and maintain methods, equipment, and temporary construction as necessary for controls over environmental conditions at the construction site and adjacent areas.

B. Comply with statutes, regulations, and ordinances which relate to the proposed Work for the prevention of environmental pollution and preservation of natural resources, including but not limited to the National Environmental Policy Act of 1969, PL 91-190, Executive Order 11514.

C. Recognize and adhere to the environmental requirements of the Project. Disturbed areas shall be strictly limited to boundaries established by the Contract Documents. Particularly avoid pollution of "on-site" streams, sewers, wells, or other water sources. The City recognizes that the project area has considerable natural value and that construction of projects should be completed with a minimum of impact to the surrounding environment. Attention is directed to this concept. Adopt construction procedures that do not cause unnecessary excavation and filling of the terrain, indiscriminate destruction of vegetation, air or stream pollution, nor the harassment or destruction of wildlife.

D. Burning of rubbish, debris or waste materials is not permitted.

1.15 POLLUTION CONTROL

A. Provide methods, means, and facilities required to prevent contamination of soil, water or atmosphere by discharge of noxious substances from construction operations.

B. Provide equipment and personnel to perform emergency measures required to contain any spillage, and to remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-site in accordance with laws and regulations, and replace with suitable compacted fill and topsoil.

C. Take special measures to prevent harmful substances from entering public waters. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.

D. Provide systems for control of atmospheric pollutants.

1. Prevent toxic concentrations of chemicals.

2. Prevent harmful dispersal of pollutants into the environment.

E. Use equipment during construction that conforms to current Federal, State, and local laws and regulations.

1.16 PEST AND RODENT CONTROL

A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.

B. Employ methods and use materials which will not adversely affect conditions at the site or on adjoining properties.

1.17 NOISE CONTROL

A. Provide vehicles, equipment, and construction activities that minimize noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and City Ordinances and in no case will noise levels be permitted which create a nuisance in the surrounding neighborhoods.

B. Conduct construction operations during daylight hours except as approved by Owner Representative.

1.18 DUST CONTROL

A. Control objectionable dust caused by operation of vehicles and equipment. Apply water or use other methods, subject to approval of the Owner Representative, which will control the amount of dust generated.

1.19 WATER RUNOFF AND EROSION CONTROL

A. Provide methods to control surface water, runoff, subsurface water, and water pumped from excavations and structures to prevent damage to the Work, the site, or adjoining properties.

B. Control fill, grading and ditching to direct water away from excavations, pits, and other construction areas; and to direct drainage to proper runoff courses so as to prevent any erosion, sedimentation or damage.

C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

D. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site or to adjoining areas and in conformance with environmental requirements.

E. Retain existing drainage patterns external to the construction site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as needed to control conditions.

F. Plan and execute construction and earth work by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.

1. Keep to a minimum the area of bare soil exposed at one time.

2. Provide temporary control measures, such as berms, dikes, and drains.

G. Construct fills and waste areas by selective placement to eliminate surface silts or clays which will erode.

H. Inspect earthwork periodically to detect any evidence of the start of erosion. Apply corrective measures as required to control erosion.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01505

MOBILIZATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Mobilization of construction equipment and facilities onto the site or sites.

1.02 UNIT PRICES

A. Measurement for mobilization is on a lump sum basis and shall not exceed 3% of the base bid.

B. Mobilization payments may be included in monthly payment estimates upon written application by Contractor, subject to the following provisions:

Authorization for payment of 50 percent of the contract price for mobilization will be made upon receipt and approval by Owner's Representative of the following items, as applicable:

a. Physical equipment, heavy machinery, etc. at, or near project site adequate for performing construction work as per contract documents. City of Galveston reserves the right to adjust payment depending on equipment, machinery, etc., present at the time of payment application. All equipment shall be in excellent operational condition ready for project use. Mobilized equipment must be adequate for project needs.

b. Bonds and Insurance

c. Submittal Schedule (Specification Section 01300)

d. Schedule of values (Specification Section 01292)

e. Traffic Control Plan, as applicable (Specification Section 01579)

f. Trench safety program (Specification Section 01526)

g. Construction schedule (Specification Section 01310)

h. Construction Photographs (Specification Section 01380)

i. Building Permit (for Facility Projects)

Authorization for payment of the remaining 50 percent of the mobilization will be made upon completion and acceptance of the project which shall include removal of the equipment and heavy

machinery, de-mobilization and cleanup per Specification Section 01710 and all applicable specifications including but not limited to:

A. Mobilization payments will be subject to retainage amounts stipulated in the General Conditions.

B. Only one mobilization shall be paid for projects with multiple locations. Movement within the project shall be incidental.

C. De-mobilization costs, including site cleanup and restoration to existing (or better) conditions, are incidental and the Contractor is responsible for de-mobilization from the site in conformance with the requirements of these contract documents.

D. To minimize the inconvenience to the public and to maintain better quality control, the total of all demolition, construction and testing activities cannot exceed 2-lanes in one direction (includes parking lane) for a total length of one-thousand (1,000) linear feet or three City Blocks in length, whichever is less.

E. Contractor shall not de-mobilize from the project site before completion and acceptance of the project and without a written approval from the owner.

PART 2 P R O D U C T S – NOT USED

PART 3 E X E C U T I O N – NOT USED

END OF SECTION

SECTION 01526

TRENCH SAFETY SYSTEMS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Trench safety system for the construction of trench excavations.

B. Trench safety system for structural excavations which fall under provisions of State and Federal trench safety laws.

1.02 UNIT PRICES

A. Measurement for trench safety systems used on trench excavations is on a linear foot basis, when listed as a separate unit price within the bid proposal, measured along the centerline of the trench, including manholes and other line structures. If no trench safety unit price is listed within the bid proposal, any trench safety required for the work will be considered incidental to the work performed. No separate measurement will be made of shoring systems used by the Contractor for protection unless identified as Special Shoring on the Drawings. Shoring, other than Special shoring, will be included in the trench safety system measurements.

B. Measurement for Special Shoring system installations shown on the Drawings and included in the bid schedule for trench excavations, is on a square foot basis, or lump sum basis, as specified in the bid proposal.

C. No payment will be made for trench safety systems for structural excavations under this section. Include payment for trench safety system in applicable structure installation sections.

1.03 DEFINITIONS

A. A trench is defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.

B. The trench safety system requirements apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and the installation to dimensions equivalent to a trench as defined.

C. Competent Person is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous,

or dangerous to employees, and who has authorization to take prompt corrective measure to eliminate them.

D. Trench Safety Systems include both Protective Systems and Shoring Systems but are not limited to sloping, sheeting, trench boxes or trench shields, slide rail systems, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

1. Protective Systems: A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of an adjacent structure.

2. Shoring System: A structure that supports the sides of an excavation and which is designed to prevent cave-ins, or to prevent movements of the ground affecting adjacent installations or improvements.

3. Special Shoring: A shoring system meeting Special Shoring Requirements for locations identified on the Drawings.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of sections and provisions of these specifications.

B. Submit a safety program specifically for the construction of trench excavation. Design the trench safety program to be in accordance with OSHA 29CFR standards governing the presence and activities of individuals working in and around trench excavations, and in accordance with any Special Shoring requirements at locations shown on the Drawings.

C. Have construction and shop drawings for trench safety systems sealed as required by OSHA by a licensed Professional Engineer retained and paid by the Contractor.

D. Review of the safety program by the Owner Representative will only be in regard to compliance with the Contract Documents and will not constitute approval by the Owner or the Owner Representative nor relieve Contractor of obligations under State and Federal trench safety laws.

1.05 REGULATORY REQUIREMENTS

A. Install and maintain trench safety systems in accordance with the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989 and subsequent updates. The sections that are incorporated into

these specifications by reference include Sections 1926-650 through 1926-652 and additional sections that may be adopted subsequent to the adoption of this specification.

B. The Contractor can locate a copy of the OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209 is available upon request to Contractors bidding on Owner's projects. The Owner assumes no responsibility for the accuracy of the reproduction. The Contractor is responsible for obtaining a copy of this section of the Federal Register.

C. The Contractor must comply with any legislation that has been enacted by the Texas Legislature with regard to Trench Safety Systems, is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., §756.021 (Vernon 1991).

D. Reference materials, if developed for a specific project, will be issued with the Bid Documents, including the following:

1. Geotechnical information obtained for use in design of the trench safety system.

2. Special Shoring Requirements, if applicable.

1.06 INDEMNIFICATION

A. Contractor shall indemnify and hold harmless the Owner, its employees, and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgments or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.

B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner in case the Owner is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the Contractor.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install and maintain trench safety systems in accordance with provisions of OSHA 29CFR.

B. Install specially designed trench safety systems shall be installed in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program. Install Special Shoring at the locations shown on the Drawings.

C. Obtain verification from a competent person, as identified in the Contractor's trench excavation safety program, that trench boxes and other pre-manufactured systems are certified for the actual installation conditions.

3.02 INSPECTION

A. Conduct daily inspections by Contractor or Contractor's independently retained consultant, of the trench safety systems to ensure that the installed systems and operations meet OSHA 29CFR and other personnel protection regulations requirements.

B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until necessary precautions have been taken to safeguard personnel.

C. Contractor shall maintain a permanent record of daily inspections. Upon request, the Contractor shall supply to Owner a copy of these records.

3.03 FIELD QUALITY CONTROL

A. Verify specific applicability of the selected or specially designed trench safety systems to each field condition encountered on the project.

END OF SECTION

SECTION 01535

TREE AND PLANT PROTECTION

PART 1 G E N E R A L

.01 SECTION INCLUDES

A. Tree and plant protection.

.02 UNIT PRICES

A. No separate payment will be made for work performed under this Section.

B. All trees must be protected within the ROW in the work-zone area during the construction activity.

.03 PROJECT CONDITIONS

A. Preserve and protect existing trees and plants to remain from foliage, branch, trunk, or root damage that could result from construction operations.

B. Prevent following types of damage:

1. Compaction of root zone by foot or vehicular traffic, or material storage.

2. Trunk damage from equipment operations, material storage, or from nailing or bolting.

3. Trunk and branch damage caused by ropes or guy wires.

4. Root poisoning from spilled solvents, gasoline, paint, and other noxious materials.

5. Branch damage due to improper pruning or trimming.

6. Damage from lack of water due to:

a. Cutting or altering natural water migration patterns near root zones.

b. Failure to provide adequate watering.

7. Damage from alteration of soil PH factor caused by depositing lime, concrete, plaster, or other base materials near roots.

8. Cutting of roots larger than one inch in diameter.

.04 DAMAGE ASSESSMENT

A. When trees other than those designated for removal are destroyed or badly damaged as a result of construction operations, remove and replace with same size, species, and variety up to and including 8 inches in trunk diameter. Tree larger than 8 inches in diameter shall be replaced with an 8-inch diameter tree of the same species and variety and total contract amount will be reduced by an amount determined from the following formula: $0.7854 \times D^2 \times \$10.00$ where D is diameter in inches of tree or shrub trunk measured 12 inches above grade. Contractor shall contact Owner prior to removing any tree. Owner must approve removal of any trees.

PART 2 P R O D U C T S

.01 MATERIALS

A. Asphalt paint: Emulsified asphalt or other adhesive, elastic, antiseptic coating formulated for horticultural use on cut or injured plant tissue, free from kerosene and coal creosote.

B. Burlap: Suitable for use as tree wrapping.

C. Fertilizer: Liquid containing 20 percent nitrogen, 10 percent phosphorus, and 5 percent potash.

D. All necessary tree replacements shall be as approved by Owner Representative.

PART 3 E X E C U T I O N

.01 PROTECTION AND MAINTENANCE OF EXISTING TREES AND SHRUBS

A. Except for trees and shrubs shown on Drawings to be removed, all trees and shrubs within the project area are to remain and be protected from damage.

B. For trees to be removed, as designated on the Drawings, perform the following:

1. Stake right-of-way limits and identify any tree of diameter greater than 4 inches which is to be removed. Mark trees prior to felling with an X in orange paint, clearly visible, on the trunk, and at eye level.

2. After marking trees give a minimum of 48-hours notice in writing to the Owner Representative of intent to begin felling operations.

3. Trees whose trunks are only partially in the right-of-way shall be protected and preserved as described in 3.01(C) below.

4. Trees scheduled for removal shall be sawed down and debris hauled from the site the same day. The stump shall be ground to 6” below grade and

excess grindings shall be hauled from the site the same day, so that a pile of grindings is not left where the stump was ground. Enough grindings should be left so that an open hole does not remain.

5. Only those trees called out for removal in the drawings shall be removed. Should it be determined that any additional trees must be removed, a permit must be applied for and approved from the City.

6. Trees designated for removal shall be hauled off and removed at Contractors expense. Disposal methods are to be approved by Owner. Owner reserves the right to take possession of the removed trees.

C. For trees or shrubs to remain, perform the following:

1. Trim trees and shrubs only as necessary and in accordance with the recommendations of a licensed arborist employed by the Contractor.

a. Trees and shrubs requiring pruning for construction should also be pruned for balance as well as to maintain proper form and branching habit.

b. Cut limbs at branch collar. No stubs should remain on trees. Branch cuts should not gouge outer layer of tree structure or trunk.

2. Use extreme care to prevent excessive damage to root systems.

a. A licensed arborist shall be employed by the Contractor before any root damage occurs. Should root damage be unavoidable, with licensed arborist approval, the following should be followed:

(1). Roots in construction areas will be cut smoothly with a trencher before excavation begins. Do not allow ripping of roots with a backhoe or other equipment.

(2). Temporarily cover exposed roots with wet burlap to prevent roots from drying out.

(3). Cover exposed roots with soil as soon as possible.

3. Prevent damage or compaction of root zone (area below dripline) by construction activities.

a. Do not allow scarring of trunks or limbs by equipment or other means.

b. Do not store construction materials, vehicles, or excavated material under dripline of trees.

c. Do not pour liquid materials under dripline.

4. Water and fertilize trees and shrubs that will remain to maintain their health during construction period.

a. Supplemental watering of landscaping during construction should be done once every 7 days in cold months and once every 4 days in hotter months.

b. This watering shall consist of saturating soils at least 6 to 8 inches beneath surface.

5. Water areas currently being served by private sprinkler systems while systems are temporarily taken out of service to maintain health of existing landscapes.

6. At option of the Contractor and with the Owner Representative's permission, trees and shrubs to remain may be temporarily transplanted and returned to original positions under supervision of a licensed arborist.

.02 PROTECTION

A. Protection of Trees or Shrubs in Open Area:

1. Install steel drive-in fence posts in protective circle, approximately 8 feet on center, not closer than 4 feet to trunk of trees or stems of shrubs.

2. Drive steel drive-in fence posts 3 feet minimum into ground, leaving 5 feet minimum above ground.

3. Mount steel hog-wire on fence posts.

4. For trees or shrubs in paved areas, mount concrete-filled steel pipe 2-1/2 inches in diameter minimum in rubber auto tires filled with concrete (movable posts).

B. Timber Wrap Protection for Trees in Close Proximity of Moving or Mechanical Equipment and Construction Work:

1. Wrap trunk with layer of burlap.

2. Install 2 x 4's or 2 x 6's (5-foot to 6-foot lengths) vertically, spaced 3 inches to 5 inches apart around circumference of tree trunk.

3. Tie in place with 12 to 9 gage steel wire.

.03 MAINTENANCE OF NEWLY PLANTED TREES

A. Water trees during dry periods.

B. The Contractor guarantees that trees planted for this Project shall remain alive and healthy at least until the end of a one-year warranty period.

1. Within four weeks of notice from Owner, Contractor shall replace, at his expense, any dead trees or any trees that in the opinion of Owner, have become unhealthy or unsightly or have lost their natural shape as a result of additional growth, improper pruning or maintenance, or weather conditions.

2. When tree must be replaced, the guarantee period for that tree shall begin on date of replacement of tree, subject to the Owner's inspection, for no less than one year.

3. Straighten leaning trees and bear entire cost.

4. Dispose of trees rejected at any time by Owner Representative at Contractor's expense.

END OF SECTION

SECTION 01563

CONTROL OF GROUND WATER AND SURFACE WATER

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Dewatering, depressurizing, draining, and maintaining trench and structure excavations and foundation beds in dry and stable condition.

B. Protecting work against surface runoff and rising flood waters.

C. Disposing of removed water.

1.02 METHOD OF PAYMENT

A. Subsurface investigation and groundwater control plan preparation and monitoring shall be incidental to the project and shall include subsurface investigation to identify groundwater conditions, design, install, operate, maintain, and monitor ground water control systems.

B No separate payment will be made for control of ground water and surface water except for well pointing and piezometer. Include the cost to control ground water and surface water in unit price for work requiring such controls. Dewatering required for the removal of standing water, surface drainage seepage, or to protect against rising waters or floods shall be considered incidental to work.

C. No separate payment will be made for well pointing unless it is listed as a pay item on the bid documents. If the well pointing is denoted on the bid documents, well pointing shall be paid by the linear foot and measured along the centerline of the utility installed regardless if well pointing is required on one or both sides of the trench.

D. Piezometers and environmental monitoring wells, if required, shall be paid for by the unit of each.

1.03 DEFINITIONS

A. Ground water control includes both dewatering and depressurization of water-bearing soil layers.

1. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from slopes or bottoms of excavations and disposing

of removed water. The intent of dewatering is to increase stability of excavated slopes; prevent dislocation of material from slopes or bottoms of excavations; reduce lateral loads on sheeting and bracing; improve excavating and hauling characteristics of excavated material; prevent failure or heaving of the bottom of excavations; and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization includes reduction in piezometric pressure within strata not controlled by dewatering alone, as required to prevent failure or heaving of excavation bottom.

B. Excavation drainage includes keeping excavations free of surface and seepage water.

C. Surface drainage includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect the Work from any source of surface water.

D. Equipment and instrumentation for monitoring and control of the ground water control system includes piezometers and monitoring wells, and devices, such as flow meters, for observing and recording flow rates.

1.04 PERFORMANCE REQUIREMENTS

A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems.

B. Design a ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Section 01526 - Trench Safety Systems, to produce the following results:

1. Effectively reduce the hydrostatic pressure affecting excavations.

2. Develop a substantially dry and stable subgrade for subsequent construction operations.

3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities, and other work.

4. Prevent the loss of fines, seepage, boils, quick condition, or softening of the foundation strata.

5. Maintain stability of sides and bottom of excavations.

C. Ground water control systems may include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.

D. Provide drainage of seepage water and surface water, as well as water from any other source entering the excavation. Excavation drainage may include placement of drainage materials, such as crushed stone and filter fabric, together with sump pumping.

E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.

F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and any settlement or resultant damage caused by the ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of the system to protect property as required.

H. Provide an adequate number of piezometers installed at the proper locations and depths as required to provide meaningful observations of the conditions affecting the excavation, adjacent structures, and water wells.

I. Provide environmental monitoring wells installed at the proper locations and depths as required to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into the work area or into the ground water control system.

J. Decommission piezometers and monitoring wells installed during design phase studies and left for Contractors monitoring and use.

K. Contractor is responsible for determining the path for the flow of the diverted water. Further, Contractor shall obtain any easements and permits required for the path and follow all local, state and federal requirements, including requirements for erosion control. Path shall direct water to the bay if possible instead of ocean side of the island.

1.05 SUBMITTALS

A. Submittals shall conform to all sections and provisions of these contract documents.

B. Submit a Ground Water and Surface Water Control Plan for review by the Owner's Representative prior to start of any field work. Submit a plan to include the following:

1. Results of subsurface investigation and description of the extent and characteristics of water bearing layers subject to ground water control.

2. Names of equipment suppliers and installation subcontractors.

3. A description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria, and operation and maintenance procedures.

4. A description of proposed monitoring and control system indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics.

5. A description of proposed filters including types, sizes, capacities and manufacturer's application recommendations.

6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.

7. Operating requirements, including piezometric control elevations for dewatering and depressurization.

8. Excavation drainage methods including typical drainage layers, sump pump application and other necessary means.

9. Surface water control and drainage installations.

10. Proposed methods and locations for disposing of removed water.

C. Submit the following records upon completed initial installation:

1. Installation and development reports for well points, eductors, and deep wells.

2. Installation reports and baseline readings for piezometers and monitoring wells.

3. Baseline analytical test data of water from monitoring wells.

4. Initial flow rates.

D. Submit the following records on a weekly basis during operations:

1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.02, Requirements for Eductor, Well Points, or Deep Wells.

2. Maintenance records for ground water control installations, piezometers, and monitoring wells.

E. Submit the following records at end of work. Decommissioning (abandonment) reports for monitoring wells and piezometers installed by other during the design phase and left for Contractor's monitoring and use.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of agencies having jurisdiction.

B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.

C. Obtain permit from EPA under the Texas Pollutant Discharge Elimination System (TPDES), for storm water discharge from construction sites. Refer to Section 01565 TPDES Permit Requirements.

D. Obtain all necessary permits from agencies with control over the use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Because the review and permitting process may be lengthy, take early action to pursue and submit for the required approvals.

E. Monitor ground water discharge for contamination while performing pumping in the vicinity of potentially contaminated sites.

F. Discharge with high levels of salinity shall be discharge directly to salt water body and shall not be conveyed by surface drainage or open ditch that may kill vegetation.

PART 2 P R O D U C T S

2.01 EQUIPMENT AND MATERIALS

A. Equipment and materials are at the option of Contractor as necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review of the Owner’s Representative through submittals.

B. Eductors, well points, or deep wells, where used, must be furnished, installed and operated by an experienced contractor regularly engaged in ground water control system design, installation, and operation.

C. All equipment must be in good repair and operating order.

D. Sufficient standby equipment and materials shall be kept available to ensure continuous operation, where required.

E. When well-pointing in residential areas, utilize noise reducing pumps and said pumps must be approved by the Owner.

PART 3 E X E C U T I O N

3.01 GROUND WATER CONTROL

A. Perform a subsurface investigation by borings as necessary to identify water bearing layers, piezometric pressures, and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine the drawdown characteristics of the water bearing layers. The results shall be presented in the Ground Water and Surface Water Control Plan (See Paragraph 1.05B.1).

B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in a manner compatible with construction methods and site conditions. Monitor effectiveness of the installed system and its effect on adjacent property.

C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Owner's Representative in writing of any changes made to accommodate field conditions and changes to the Work. Provide revised drawings and calculations with such notification.

D. Provide for continuous system operation, including nights, weekends, and holidays. Arrange for appropriate backup if electrical power is primary energy source for dewatering system.

E. Monitor operations to verify that the system lowers ground water piezometric levels at a rate required to maintain a dry excavation resulting in a stable subgrade for prosecution of subsequent operations.

F. Where hydrostatic pressures in confined water bearing layers exist below excavation, depressurize those zones to eliminate risk of uplift or other instability of excavation or installed works. Allowable piezometric elevations shall be defined in the Ground Water and Surface Water Control Plan.

G. Maintain water level below subgrade elevation. Do not allow levels to rise until foundation concrete has achieved design strength.

H. During backfilling, dewatering may be reduced to maintain water level a minimum of 5 feet below prevailing level of backfill. However, do not allow that water level to result in uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement stabilized sand until at least 48 hours after placement.

I. Provide a uniform diameter for each pipe drain run constructed for dewatering.

J. Extent of construction ground water control for structures with a permanent perforated underground drainage system may be reduced, such as for units designed to withstand hydrostatic uplift pressure. Provide a means of draining the affected portion of underground system, including standby equipment. Maintain drainage system during operations and remove it when no longer required.

K. Remove system upon completion of construction or when dewatering and control of surface or ground water is no longer required.

L. Backfill all well-pointed holes.

M. Compact backfill to not less than 95 percent of the maximum dry density in accordance with ASTM D698.

3.02 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between every eductor well or well point and discharge header so that discharge from each installation can be visually monitored.

B. Install sufficient piezometers or monitoring wells to show that all trench or shaft excavations in water bearing materials are predrained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for Contractor's selected method of work.

C. Install piezometers or monitoring wells not less than one week in advance of beginning the associated excavation as required in Contractor’s best judgment.

D. Dewatering may be omitted for portions of underdrains or other excavations, but only where auger borings and piezometers or monitoring wells show that soil is predrained by an existing system such that the criteria of the ground water control plan are satisfied.

E. Replace installations that produce noticeable amounts of sediments after development.

F. Provide additional ground water control installations, or change the methods, in the event that the installations according to the ground water control plan does not provide satisfactory results based on the performance criteria defined by the plan and by the specification. Submit a revised plan. No separate pay for the additional plan.

3.03 MAINTENANCE AND OBSERVATION

A. Conduct daily maintenance and observation of piezometers or monitoring wells while the ground water control installations or excavation drainage are operating in an area. Keep system in good condition.

B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedule.

C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make observations, as specified.

D. Remove and grout piezometers inside or outside the excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by the Owner's Representative.

3.04 MONITORING AND RECORDING

A. Monitor and record average flow rate of operation for each deep well, or for each well point or eductor header used in dewatering system. Also monitor and record water level and ground water recovery. These records shall be obtained daily until steady conditions are achieved, and twice weekly thereafter.

B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until the Work is completed or piezometers or wells are removed, except when Owner's Representative determines that more frequent monitoring and recording are required. Comply with Owner's Representative's direction for increased monitoring and recording and take measures as necessary to ensure effective dewatering for intended purpose.

3.05 SURFACE WATER CONTROL

A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. The requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.

B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by such agencies.

END OF SECTION

SECTION 01564

WASTE MATERIAL DISPOSAL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Disposal of waste material and salvageable material.

1.02 UNIT PRICES

A. No separate payment will be made for waste material disposal under this Section. Include payment in unit price for related work.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all Sections and provisions of these contract documents.

B. Obtain and submit disposal permits for proposed disposal sites if required by local ordinances. Disposed material placed as fill shall be approved by the Owner and shall be in accordance with all local, state and federal requirements.

C. Submit a copy of written permission from property owner, along with description of property, prior to disposal of excess material adjacent to the Project. Submit a written and signed release from property owner upon completion of disposal work.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 SALVAGEABLE MATERIAL

A. Excavated material: When indicated on Drawings, load, haul, and deposit excavated material at a location or locations shown on Drawings outside the limits of Project.

B. Base, surface, and bedding material: Deliver shell, gravel, bituminous, or other base and surfacing material designated for salvage to the location designated by the Owner’s Representative.

C. Pipe culvert: Deliver culverts designated for salvage to Owner’s storage area.

D. Other salvageable materials: Conform to requirements of individual Specification Sections.

E. Coordinate delivery of salvageable material with Owner's Representative.

3.02 EXCESS MATERIAL

A. Vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage, shall become the property of Contractor and shall be removed from the job site and legally disposed of at no cost to the Owner. Upon Owner's request, Contractor to provide disposal site of material.

B. Excess soil may be deposited on private property adjacent to the Project when written permission is obtained from property owner and permits are obtained. See Paragraph 1.03 C above.

C. Waste materials shall be removed from the site on a daily basis, such that the site is maintained in a neat and orderly condition.

END OF SECTION

SECTION 01565

TPDES REQUIREMENTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Documentation to be prepared and signed by Contractor before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000 issued February 15, 2008 (the Construction General Permit) or latest revision.

B. Implementation, maintenance inspection, and termination of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other practices shown on the Drawings or specified elsewhere in the Contract.

C. Review implementation of the Storm Water Pollution Prevention Plan (SW3P or SWPPP) in a meeting with Project Manager prior to start of construction.

1.02 DEFINITIONS

A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavating.

B. Large Construction Activity: Project that:

1. disturbs five acres or more, or

2. disturbs less than five acres but is part of a larger common plan of development that will disturb five acres or more of land.

C. Small Construction Activity: Project that:

1. disturbs one or more acres but less than five acres, or

2. disturbs less than one acre but is part of a larger common plan of development that will ultimately disturb one or more acres but less than five acres.

D. TPDES Operator:

1. Provide the name and contact information for the designated TPDES operator.
2. The TPDES operator is the person or persons who have day-to-day operational control of the construction activities which are necessary to ensure compliance with the SW3P for the site or other Construction General Permit conditions.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N

3.01 SITE SPECIFIC STORM WATER POLLUT1ON PREVENTION PLAN (SW3P)

A. Prepare a SW3P following Part III of the Construction General Permit, if required.

B. Update or revise the SW3P as needed during the construction following Part III, Section E of the Construction General Permit.

C. Submit the SW3P and any updates or revisions to Owner's Representative for review and address comments prior to commencing, or continuing, construction activities.

3.02 NOTICE OF INTENT FOR LARGE CONSTRUCTION ACTIVITY

A. Fill out, sign, and date TCEQ Form 20022 (03/05/2008) "Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR 150000)", **Attachment 1** of this section.

B. Transmit the signed Contractor's copy of TCEQ Form 20022 (03/05/2008), along with a $325.00 check or required fee, made out to Texas Commission on Environmental Quality, and the completed Payment Submittal Form to the Owner's Representative.

C. Owner's Representative will complete a separate TCEQ Form 20022 (03/05/2008) for City's Notice of Intent, and will submit both Notices, along with checks for application fees, to the TCEQ.

D. Submission of the Notice of Intent form by both the Contractor to TCEQ is required a minimum of two days before Commencement of Construction Activities.

E. Fill out, sign, and date the "Construction Site Notice", Attachment 2A to TPDES General Permit TXR 150000, "Construction Site Notice", **Attachment 2A** of this section.

F. Transmit the signed Construction Site Notice to at least seven days prior to Commencement of Construction Activity.

3.03 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY

A. Fill out, sign, and date the "Construction Site Notice", Attachment 2B to TPDES General Permit TXR 150000, "Construction Site Notice", **Attachment 2B** of this section.

B. Transmit the signed Construction Site Notice to Owner's Representative at least seven days prior to Commencement of Construction Activity.

3.04 CERTIFICATION REQUIREMENTS

A. Fill out TPDES Operator's Information form, **Attachment 3** of this section, including Contractor's name, address, and telephone number, and the names of persons or firms

responsible for maintenance and inspection of erosion and sediment control measures. Use multiple copies as required to document full information.

B. Contractor and Subcontractors shall sign and date the Contractor's / Subcontractor's Certification for TPDES Permitting, **Attachment 4** of this section. Include this certification with other Project certification forms.

C. Submit properly completed certification forms to Owner's Representative for review before beginning construction operations.

D. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measures read, fill out, sign, and date the Erosion Control Contractor's Certification for Inspection and Maintenance. Use the EPA NPDES Construction Inspection Form, **Attachment 5** of this section; and the Storm Water Pollution Prevention Plan Construction Site Inspection Report, **Attachment 6** of this section to record maintenance inspections and repairs.

3.05 RETENTION OF RECORDS

A. Keep a copy of this document and the SW3P in a readily accessible location at the construction site from the Commencement of Construction Activity until submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR 150000). Contractors with day-to-day operational control over SW3P implementation shall have a copy of the SW3P available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SW3P. Upon submission of the NOT, submit all required forms and a copy of the SW3P with all revisions to the Owner's Representative.

3.06 REQUIRED NOTICES

A. Post the following notices from effective date of the SW3P until date of final site stabilization as defined in the Construction General Permit:

1. Post the TPDES permit number for Large Construction Activity, or a signed TCEQ Construction Site Notice for Small Construction Activity. Signed copies of the Contractor's NOI must also be posted.
2. Post notices near the main entrance of the construction site in a prominent place for public viewing. Post name and telephone number of Contractor's local contact person, brief project description and location of the SW3P.
    a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with Owner's Representative to conform to requirements of the Construction General Permit.
    b. If Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move notice as necessary.
3. Post a notice to equipment and vehicles operators, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post at each

stabilized construction exit area.

4. Post a notice of waste disposal procedures in a readily visible location on site.

3.07 ON-SITE WASTE MATERIAL STORAGE

A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.

B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SW3P.

C. Prepare description of controls to reduce Pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with industrial program best management practices. Keep a copy of the description with the SW3Ps.

3.08 NOTICE OF TERMINATION

A. Submit a NOT, **Attachment 7** of this section, to Owner's Representative within 30 days after:

1. Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or
2. Another operator has assumed control over all areas of the site that have not been stabilized; and
3. All silt fences and other temporary erosion controls have either been removed, scheduled to be removed as defined in the SW3P, or transferred to a new operator in the new operator has sought permit coverage.

B. Contractor will complete NOT and submit Contractor and City's notices to the TCEQ and MS4 entities.

ATTACHMENT 1

Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under TPDES General Permit (TXR150000)

TCEQ Office Use Only
Permit No.: TXR15
RN:
CN:
Ref No:



Sign up now for ePermits NOI at https://www6.tceq.state.tx.us/steers/
Get Instant Permit Coverage and only pay a $225 application fee.

Reset Form

If filing a paper NOI you can pay the application fee on line? Go to https://www6.tceq.state.tx.us/epay/

Select Fee Type: GENERAL PERMIT CONSTRUCTION STORM WATER DISCHARGE NOI APPLICATION

IMPORTANT:
- Use the **INSTRUCTIONS** to fill out each question in this form.
- Use the attached **CUSTOMER CHECKLIST** to make certain all you filled out all required information.
- Incomplete applications **WILL** delay approval or result in **automatic Denial**.

Renewal of General Permit
Is this NOI to renew an ACTIVE permit?
☐ Yes - What is your permit number? **Permit No. TXR15_____**
☐ No - a permit number will be issued.

Application Fee if mailing a paper NOI:
You must pay the $325 Application Fee to TCEQ for the application to be considered complete.
Payment and NOI must be mailed to separate addresses. See instructions for correct mailing addresses.

Provide your payment information below, for us to verify payment of the application fee:

☐ Mailed:	Check/Money Order No.:	Company Name on checking account:
☐ EPAY:	Voucher No.:	Is the Payment Voucher copy attached? ☐ Yes

A. OPERATOR (applicant)

1. If the applicant is currently a customer with TCEQ, what is the Customer Number (CN) issued to this entity?
CN (Search Central Registry)

2. What is the Legal Name of the entity (applicant) applying for this permit?

(The legal name must be spelled exactly as filed with the Texas Secretary of State, County, or in the legal document forming the entity.)

3. What is the name and title of the person signing the application?
(The person must be an official meeting signatory requirements in TAC 305.43(a).)

Name:	Job Title:

4. What is the Operator's (applicant) mailing address as recognized by the **US Postal Service**? (verify at USPS.com)

Address:	Suite No./Bldg. No./Mail Code:	
City:	State:	ZIP Code:
Country Mailing Information (if outside USA).	Country Code:	Postal Code:

5. Phone No.: ( )	Extension:
6. Fax No.: ( )	E-mail Address:

7. Indicate the type of Customer:

☐ Individual	☐ Sole Proprietorship-D.B.A.	☐ Limited Partnership
☐ Corporation	☐ Federal Government	☐ General Partnership
☐ State Government	☐ County Government	☐ City Government
☐ Other Government	☐ Other (describe):	

ATTACHMENT 1

8. Independent Operator: ☐Yes ☐No (If governmental entity, subsidiary, or part of a larger corporation, check "No".)	
9. Number of Employees: ☐0-20; ☐21-100; ☐101-250; ☐251-500; or ☐501 or higher	
10. Customer Business Tax and Filing Numbers *(This item is not applicable to Individuals, Government, GP or Sole Proprietor.)* **REQUIRED** for Corporations and Limited Partnerships **(Verify the entity's status and filing no. with TX SOS at 512/463-5555)**	
State Franchise Tax ID Number:	Federal Tax ID:
TX SOS Charter (filing) Number:	DUNS Number (if known):

B. APPLICATION CONTACT

If TCEQ needs additional information regarding this application, who should be contacted?

1. Name:	Title:	Company:
2. Phone No.: ( )	Extension:	
3. Fax No.:	E-mail Address:	

C. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

1. TCEQ Issued RE Reference Number (RN): **RN**

(Search Central Registry)

2. Name of Project or Site (the name as known by the community where this facility/project is located):

(example: phase and name of subdivision or name of project that's unique to the site)

3. Does the site have a physical address?

If Yes, complete **Section A** for a physical address.

If No, complete **Section B** for site location information.

Section A: Enter the physical address for the site. **(verify it with USPS.com or other delivery source)**

Street Number:	Street Name:
City:	ZIP Code:

Section B: Enter the site location information.

If no physical address (Street Number & Street Name), provide a written location access description to the site:
(Ex.: phase 1 of Woodland subdivision located 2 miles west from intersection of Hwy 290 & IH35 accessible on Hwy 290 South)

City where the site is located or nearest city to site:	ZIP Code where site is located:

4. Identify the county where the site is located:

5. Latitude:	Longitude:

6. What is the primary business of this entity? In your own words, briefly describe the primary business of the Regulated Entity:
(Do not repeat the SIC and NAICS code)

7. What is the mailing address for the regulated entity?

Is the RE mailing address the same as the Operator? ☐Yes, address is the same as Operator ☐No, provide the address

Street Number:	Street Name:	
City:	State:	ZIP Code:

D. GENERAL CHARACTERISTICS

1. Is the site located on Indian Country Lands? ☐No ☐Yes – If Yes, do not submit this NOI. Contact EPA, Region VI
If the site is on Indian country lands, you must obtain authorization through EPA, Region VI.

2. What is the Standard Industrial Classification (SIC) code (see instructions for common codes): **(Search Osha.gov)**

Primary: _____ Secondary: _____

ATTACHMENT 1

3(a) What is the total number of acres disturbed? _____

3(b) Is the project site part of a larger common plan of development or sale? ☐ Yes ☐ No

If **Yes**, the total number of acres disturbed can be less than 5 acres.

If **No**, the total number of acres disturbed must be 5 or more. If the total number of acres disturbed is less than 5 then the project site does not qualify for coverage through this Notice of Intent. Coverage will be denied. See the requirements in the general permit for small construction sites.

4. Discharge Information **(all information MUST be provided or the permit will be denied)**

4(a) What is the name of the water body(s) to receive the storm water runoff or potential runoff from the site?

4(b) What is the segment number(s) of the classified water body(s) that the discharge or potential discharge will eventually reach?

4(c) Are any of the surface water bodies receiving discharges from the construction site on the latest EPA-approved CWA 303(d) list of impaired waters?

☐ Yes ☐ No

If Yes, provide the name of the impaired water body(s). _____

4(d) Is the discharge into an MS4? ☐ Yes ☐ No

If **Yes**, what is the name of the MS4 Operator? _____

Note: The general permit requires you to send a copy of the NOI to the MS4 Operator.

4(e) Is the discharge or potential discharge within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer?

☐ Yes ☐ No

If the answer is Yes, please note that a copy of the agency approved Plan required by the Edwards Aquifer Rule (30 TAC Chapter 213) must be included or referenced in the Storm Water Pollution Prevention Plan.

E. CERTIFICATION

Check "Yes" to the certifications below. **Failure to certify to all items will result in denial.**

☐ Yes	I certify that I have obtained a copy and understand the terms and conditions of the general permit (TXR150000).
☐ Yes	I certify that the full legal name of the entity (Operator) applying for this permit has been provided and is legally authorized to do business in Texas.
☐ Yes	I understand that a Notice of Termination (NOT) must be submitted when this authorization is no longer needed.
☐ Yes	I certify that a storm water pollution prevention plan has been developed and implemented prior to construction, and that is compliant with any applicable local sediment and erosion control plans and prepared and implemented as required in the general permit TXR150000.

Operator Certification:

I, _____ _____

Typed or printed name *(Required & must be legible)* Title *(Required & legible)*

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I further certify that I am authorized under 30 Texas Administrative Code §305.44 to sign and submit this document, and can provide documentation in proof of such authorization upon request.

Signature: _____ Date: _____

(Use blue ink)

ATTACHMENT 1

Did you complete everything? Use this checklist to be sure!

Are you ready to mail your form to TCEQ? Go to the General Information Section of the Instructions for mailing addresses.

	Customer GP Notice of Intent Checklist **TXR150000**
√	This checklist is for use by the operator to ensure a complete application. Missing information may result in denial of coverage under the permit. (See NOI Process description in the Instructions)
☐	**Application Fee of $325.00** was mailed separately to TCEQ's Cashiers's Office (separate from the NOI) or the EPAY payment voucher is attached.
	OPERATOR INFORMATION - Confirm each item is complete:
☐	√ Customer Number (CN) issued by TCEQ Central Registry
☐	Legal Name as filed to do business in Texas (Call TX SOS 512/463-5555)
☐	Name and Title of person signing the application. This person must meet signatory requirements in 30 TAC Section 305.43
☐	Operator Mailing Address is complete & verifiable with USPS. www.usps.com
☐	Phone Numbers/E-mail Address
☐	Type of Operator (Entity Type)
☐	Independent Operator
☐	Number of Employees
☐	For Corporations or Limited Partnerships – Tax ID and SOS Filing numbers are REQUIRED
	Application Contact person we can call for questions about this application.
	REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE - Confirm each item is complete:
☐	√ Regulated Entity Reference Number (RN) (if site is already regulated by TCEQ)
☐	Site/Project Name/Regulated Entity
☐	Site/Project (RE) Physical Address Please do not use a rural route or post office box for a site location
☐	**Or** if no physical address, the location information that includes description, zip code and city is listed.
☐	Latitude and Longitude TCEQ USGS Topographic Map Viewer or TerraServer-USA
☐	Business description
☐	Site Mailing Address (checked same as operator or complete & verifiable with USPS. www.usps.com)
	GENERAL CHARACTERISTICS - Confirm each item is complete:
☐	√ Indian Country Lands –the facility is not on Indian Country Lands
☐	Standard Industrial Classification (SIC) code www.osha.gov/oshstats/sicser.html
☐	Acres Disturbed is provided and qualifies for coverage through a NOI.
☐	Common plan of development or for sale?
☐	Discharge Information:
☐	receiving water body
☐	segment number(s) is REQUIRED
☐	water body on the latest EPA-Approved Clean Water Act 303(d) list of impaired waters
☐	MS4 Operator
☐	Edwards Aquifer Rule
☐	**CERTIFICATION** Certification statements have been checked indicating "Yes" Signature meets 30 Texas Administrative Code (TAC) §305.44 and is original and has been provided for the Operator.

ATTACHMENT 1

Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under TPDES General Permit (TXR150000)
General Information and Instructions

GENERAL INFORMATION

Where to Send the Notice of Intent (NOI) and other related forms:

BY REGULAR U.S. MAIL
Texas Commission on Environmental Quality
Storm Water Processing Center (MC228)
P.O. Box 13087
Austin, TX 78711-3087

BY OVERNIGHT/EXPRESS MAIL
Texas Commission on Environmental Quality
Storm Water Processing Center (MC228)
12100 Park 35 Circle
Austin, TX 78753

TCEQ Contact list:

Application Processing Questions relating to the status and form requirements:	512/239-3700, 512/245-0130 or swpermit@tceq.state.tx.us
Technical Questions relating to the general permit:	512/239-4671 or swgp@tceq.state.tx.us
Environmental Law Division:	512/239-0600
Records Management for obtaining copies of forms submitted to TCEQ:	512/239-0900
Information Services for obtaining reports from program data bases (as available):	512/239-DATA (3282)
Financial Administration's Cashier's office:	512/239-0357 or 512/239-0187

Notice of Intent Process:

When your NOI is received by the program, the form will be processed as follows:

1. **Administrative Review:** Each item on the form will be reviewed for a complete response. In addition, the operator's legal name must be verified with Texas Secretary of State as valid and active (if applicable). The address(s) on the form must be verified with the US Postal service as an address receiving regular mail delivery. Never give an overnight/express mailing address.

2. **Notice of Deficiency:** If an item is incomplete or not verifiable as indicated above, a notice of deficiency (NOD) will be mailed to the operator. The operator will have 30 days to respond to the NOD. The response will be reviewed for completeness.

3. **Acknowledgment of Coverage:** An Acknowledgment Certificate will be mailed to the operator. This certificate acknowledges coverage under the general permit.

-or-

Denial of Coverage: If the application is too incomplete to process, or the operator fails to respond to the NOD or the response is inadequate, coverage under the general permit may be denied. If coverage is denied, the operator will be notified.

General Permit (Your Permit)

If filing the NOI through ePermits online application, coverage under the general permit begins the day the NOI is submitted to TCEQ through epermits. **Sign up now for on line NOI at https://www6.tceq.state.tx.us/steers/**

If mailing a paper NOI, coverage under the general permit begins **seven (7) days after a completed NOI is postmarked for delivery to** the TCEQ. You should have a copy of your general permit when submitting your application.

You may view and print your permit for which you are seeking coverage, on the TCEQ web site http://www.tceq.state.tx.us/permitting/water_quality/stormwater/TXR15_AIR.html.

General Permit Forms

The Notice of Intent (NOI), Notice of Termination (NOT), and Notice of Change (NOC) #20391 with instructions are available in Adobe Acrobat PDF format on the TCEQ web site http://www.tceq.state.tx.us/permitting/water_quality/stormwater/TXR15_AIR.html.

Sign up now for on line Notice of Termination application at https://www6.tceq.state.tx.us/steers/

Change in Operator

An authorization under the general permit is not transferable. If the operator or owner of the regulated entity changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted not later than 10 days prior to the change in Operator status.

ATTACHMENT 1

TCEQ Central Registry Core Data Form
The Core Data Form has been incorporated into this form. **Do not send a core data form to TCEQ.**

After final acknowledgment of coverage under the general permit, the program will assign a Customer Number (CN) and Regulated Entity Number (RN). For Construction Permits, a new RN will be assigned for each Notice of Intent filed with TCEQ, since construction project sites can overlap with other Customers. The RN assigned to your construction project will not be assigned to any other TCEQ authorization.

You can find the information on the Central Registry web site at www4.tceq.state.tx.us/crpub. You can search by the Regulated Entity (RN), Customer Number (CN) or Name (Permittee), or by your permit number under the search field labeled "Additional ID". Capitalize all letters in the permit number.

The Customer (Permittee) is responsible for providing consistent information to the TCEQ, and for updating all CN and RN data for all authorizations as changes occur. For General Permits, a Notice of Change form must be submitted to the program area.

Application Fees:

$225.00 application fee if submitting the NOI through ePermits.
$325.00 application fee if submitting a paper NOI for processing.

The application fee is required to be paid at the time the NOI is submitted. Failure to submit payment at the time the application is filed will cause delay in acknowledgment or denial of coverage under the general permit.

• Mailed Payments:
DO NOT mail your check with the original Notice of Intent application.
Use the attached Application Fee payment submittal form is mailing the payment. Do not include a copy of the NOI.

BY REGULAR U.S. MAIL
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
P.O. Box 13088
Austin, TX 78711-3088

BY OVERNIGHT/EXPRESS MAIL
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
12100 Park 35 Circle
Austin, TX 78753

• ePAY Electronic Payment:
Go to https://www6.tceq.state.tx.us/epay
Select Water Quality, then select the fee category "GENERAL PERMIT CONSTRUCTION STORM WATER DISCHARGE NOI APPLICATION".
You must include a copy of the payment voucher with your NOI. Your NOI will not be considered complete without the payment voucher.

The Annual Water Quality Fee has been consolidated into the Application Fee effective March 5, 2008. An annual fee will not be assessed and billed to operators on 9/1/2008. This does not relieve the operator of fees due for prior fiscal year assessments.

The operator will continue to receive an invoice for payment of any past due annual fee. A 5% penalty will be assessed if the payment is received by TCEQ after the due date. Annual fee assessments cannot be waived as long as the authorization under the general permit was active on September 1 of the FY billed.

ATTACHMENT 1

INSTRUCTIONS FOR FILLING OUT THE NOI FORM

A. OPERATOR (As defined in the general permit.)

1. TCEQ Issued Customer Number (CN)
TCEQ's Central Registry will assign each customer a number that begins with "CN," followed by nine digits. **This is not a permit number**, registration number, or license number.
- If this customer has not been assigned a Customer Reference Number, leave the space for the Customer Reference Number blank.
- If this customer has already been assigned this number, enter the operator's Customer Reference Number in the space provided.

2. Legal Name
Provide the legal name of the facility operator, as authorized to do business in Texas. The name must be provided exactly as filed with the Texas Secretary of State (SOS), or on other legal documents forming the entity, that is filed in the county where doing business. You may contact the SOS at 512/463-5555, or go to http://www.sos.state.tx.us/corp/contact.shtml for more information related to filing in Texas. If filed in the county where doing business, provide a copy of the legal documents showing the legal name.

3. Name and Title of person signing the Notice of Intent application form. Signature meets 30 Texas Administrative Code (TAC) §305.44

4. Operator Mailing Address
Provide a complete mailing address for receiving mail from the TCEQ. The address must be verifiable with the US Postal Service at www.usps.com, for regular mail delivery (not overnight express mail). If you find that the address is not verifiable using the USPS web search, please indicate the address is used by the USPS for regular mail delivery.

5. Phone Number
This number should correspond to this customer's mailing address given earlier. Enter the area code and phone number here. Leave "Extension" blank if this customer's phone system lacks this feature.

6. Fax Number and E-mail Address
This number and E-mail address should correspond to operator's mailing address provided earlier. (Optional Information)

7. Type of Entity
Check only one box that identifies the type of entity. Use the descriptions below to identify the appropriate entity type:

Individual is a customer who has not established a business, but conducts an activity that needs to be regulated by the TCEQ.

Sole Proprietorship— D.B.A. is a customer that is owned by only one person and has not been incorporated. This business may:
- be under the person's name
- have its own name ("doing business as," or d.b.a.)
- have any number of employees

Partnership is a customer that is established as a partnership as defined by the Texas Secretary of State's Office.

Corporation is a customer that meets all of these conditions:
- is a legally incorporated entity under the laws of any state or country
- is recognized as a corporation by the Texas Secretary of State
- has proper operating authority to operate in Texas.

Government - Federal, state, county, or city government (as appropriate)
the customer is either an agency of one of these levels of government or the governmental body itself.

Other is Estate, Trust, etc.
the customer does not fit one of the above descriptions. Enter a short description of the type of customer in the blank provided.

8. Independent Operator
Check "No" if this customer is a subsidiary, part of a larger company, or is a governmental entity. Otherwise, check "Yes."

9. Number of Employees
Check one box to show the number of employees for this customer's entire company, at all locations. This is not necessarily the number of employees at the site named in the NOI.

10. State Franchise Tax ID Number
Corporations and limited liability companies that operate in Texas are issued a franchise tax identification number. If this customer is a corporation or limited liability company, enter this number here.

Federal Tax ID
All businesses, except for some small sole proprietors, individuals, or general partnerships should have a federal taxpayer identification number (TIN). Enter this number here. Use no prefixes, dashes, or hyphens. Sole proprietors, individuals, or general partnerships do not need to provide a federal tax ID.

TX SOS Charter (filing) Number
Corporations and Limited Partnerships required to register with the Texas Secretary of State are issued a charter or filing number. You may obtain further information by calling SOS at 512/463-5555 http://www.sos.state.tx.us/corp/contact.shtml.

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DUNS Number
Most businesses have a DUNS (Data Universal Numbering System) number issued by Dun and Bradstreet Corp. If this customer has one, enter it here.

B. Application Contact

Provide the name, title and communication information of the person that TCEQ can contact for additional information regarding this application.
If the application is missing information and there is no contact person to call, the application may be denied.

C. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

1. Regulated Entity Reference Number (RN)

This is a number issued by TCEQ's Central Registry to sites (a location where a regulated activity occurs) regulated by TCEQ. This is not a permit number, registration number, or license number.
- If this Regulated Entity has not been assigned a Regulated Entity Number, leave this space blank.
- If this customer has been assigned this number, enter the operator's Regulated Entity Number.

2. Site/Project Name/Regulated Entity
If the site is already regulated by TCEQ, use the same name as on the existing Regulated Entity Reference Number (RN).

If new, provide the name of the site as known by the public in the area where the site is located. The name you provide on this application will be used in the TCEQ Central Registry as the Regulated Entity.

3. Site/Project (RE) Physical Address

Section A: Enter the complete physical address of where the site is located. This must be a street number and street name for a complete physical address. This address must be validated through US Postal Service or your local police (911 service) as a valid address. Please confirm this to be a complete and valid address. In some rural areas, new addresses are being assigned to replace rural route addresses.
Please do not use a rural route or post office box for a site location.

Section B: If a site does not have an actual physical address that includes a street number and street name, then provide a complete written location access description, and the zip code and city where the site is located.
For example: "The site is located 2 miles west from intersection of Hwy 290 & IH35, located on the southwest corner of the Hwy 290 South bound lane." This includes authorizations for construction projects such as highways and subdivision.

4. Identify the County where the site is located. If the site covers more than one county, provide the county that is most affected by the authorized activity and list the additional county(s) as secondary.

5. Latitude and Longitude
Enter the latitude and longitude of the site in either degrees, minutes, and seconds or decimal form. For help obtaining the latitude and longitude, go to: TCEQ USGS Topographic Map Viewer or TerraServer-USA

6. Description of Activity Regulated
In your own words, briefly describe the primary business being conducted at the site. (A description specific to what you are doing that requires this authorization - Do not repeat the SIC Code(s).)

SITE MAILING ADDRESS

Provide a complete mailing address to be used by TCEQ for receiving mail at the site. In most cases, the address is the same as the operator. If so, simply place a check mark in the box. If you provide a different address, please verify the address with USPS as instructed above for the operator address.

D. GENERAL CHARACTERISTICS

1. **Indian Country Lands**
If your site is located on Indian Country Lands, the TCEQ does not have authority to process your application. You must obtain authorization through EPA, Region VI, Dallas. Do not submit this form to TCEQ.

Indian Country means (1) all land within the limits of any American Indian reservation under the jurisdiction of the U.S. government, notwithstanding the issuance of any patent, and including rights-of-way running throughout the reservation; (2) all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or outside the limits of a State; and (3) all Indian allotments, the Indian titles which have not been extinguished, including rights-of-way running through the same.

Indian Tribe means any Indian Tribe, band, nation, or community recognized by the Secretary of the Interior and exercising substantial governmental duties and powers.

2. **Standard Industrial Classification (SIC) code**
Provide the SIC code that best describes the construction activity being conducted at the site.
Common SIC Codes related to construction activities include: 1521 Construction of Single Family Homes; 1522 Construction of Residential Bldgs. Other than Single Family Homes; 1541 Construction of Industrial Bldgs. and Warehouses; 1542 Construction of Non-residential Bldgs. other than Industrial Bldgs. and Warehouses; 1611 Highway & Street Construction, except Highway Construction; 1622 Bridge, Tunnel, & Elevated Highway Construction; 1623 Water, Sewer, Pipeline & Communications, and Power Line Construction. For help with SIC codes, go to: www.osha.gov/oshstats/sicser.html

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3. **Estimated Area of Land Disturbed**
3(a). Provide the approximate number of acres that the construction site will disturb.
3(b). Indicate is the site is part of a common plan of development or for sale.

Construction activities that disturb less than one acre, unless they are part of a larger common plan that disturbs more than one acre, do not require permit coverage.

Construction activities that disturb between one and five acre, unless they are part of a common plan that disturbs five acres or more acres, do not require submission of an NOI. Therefore, the estimated area of land disturbed should not be less than five, unless the project is part of a larger common plan that disturbs five or more acres.

"Disturb" means any clearing, grading, excavating, or other similar activities. If you have any questions about this item, please call the storm water technical staff at (512)239-4671.

4. **Discharge Information**
4 (a). The storm water may be discharged directly to a receiving stream or through a **MS4*** from your site. It eventually reaches a receiving water body such as a local stream or lake, possibly via a drainage ditch. You must provide the name of the water body that receives the discharge from the site (a local stream or lake).

4 (b). The classified segment number(s) is REQUIRED to get coverage. Go to the link to find the segment number of the classified water body where storm water will flow http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/viewer/viewer.html . Call Water Quality Assessments at 512/239-4671 for further assistance. Another source for segments is: http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/gi/gi-316/index.html

4 (c). If any surface water body(s) receiving discharges from the construction site are on the latest EPA-approved CWA § 303(d) list of impaired waters, provide the name(s) of the water body(s).

EPA approved CWA 303d list of impaired waters can be found at: Texas Water Quality Inventory and 303(d) List - Texas Commission on Environmental Quality - www.tceq.state.tx.us

4 (d). Identify the **MS4*** Operator name if the storm water discharge is into an MS4.

***MS4 is an acronym for Municipal separate storm sewer system. MS4 is defined as** a separate storm sewer system owned or operated by a state, city, town, county, district, association, or other public body (created by or pursuant to state law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under state law such as a sewer district, flood control or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, that discharges to water in the state.

For assistance, you may call the technical staff of the Water Quality Assessment & Standards Section at 512/239-4671.

4 (e). **Edwards Aquifer Rule**
See maps on the TCEQ website to determine if the site is located within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer at http://www.tceq.state.tx.us/compliance/field_ops/eapp/viewer.html.

If the discharge or potential discharge is within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer, a site specific authorization approved by the Executive Director under the Edwards Aquifer Protection Program (30 TAC Chapter 213) is required before construction can begin.

The general permit requires the approved Contributing Zone Plan or Water Pollution Abatement Plan to be included as a part of the Storm Water Pollution Prevention Plan. The certification must be answered "Yes" for coverage under the general permit.

E. CERTIFICATIONS

Failure to indicate "Yes" to ALL of the certification items may result in denial of coverage under the general permit.

The certification must bear an original signature of a person meeting the signatory requirements specified under **30 Texas Administrative Code §305.44**

IF YOU ARE A CORPORATION:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(1) (see below). According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

IF YOU ARE A MUNICIPALITY OR OTHER GOVERNMENT ENTITY:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(3) (see below). According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statute(s) under which your government entity was formed. An NOI or

similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to §305.44(a)(3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the Texas Commission on Environmental Quality's Environmental Law Division at 512/239-0600.

30 Texas Administrative Code
§305.44. Signatories to Applications.

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

Texas Commission on Environmental Quality
General Permit Payment Submittal Form
$325 for a paper Construction NOI Application Fee

Use this form to submit your Application Fee only if you are mailing your payment.

- Complete items 1 through 5 below:
- Staple your check in the space provided at the bottom of this document.
- Do not mail this form with your NOI form.
- Do not mail this form to the same address as your NOI.

Mail this form and your check to:

BY REGULAR U.S. MAIL	BY OVERNIGHT/EXPRESS MAIL
Texas Commission on Environmental Quality Financial Administration Division Cashier's Office, MC-214 P.O. Box 13088 Austin, TX 78711-3088	Texas Commission on Environmental Quality Financial Administration Division Cashier's Office, MC-214 12100 Park 35 Circle Austin, TX 78753

Fee Code: **GPA** General Permit: TXR150000

1. Check / Money Order No:
2. Amount of Check/Money Order:
3. Date of Check or Money Order:
4. Name on Check or Money Order:

5. NOI INFORMATION

If the check is for more than one NOI, list each Project/Site (RE) Name and Physical Address exactly as provided on the NOI. DO NOT SUBMIT A COPY OF THE NOI WITH THIS FORM AS IT COULD CAUSE DUPLICATE PERMIT ENTRIES.

See Attached List of Sites (If more space is needed, you may attach a list.)

Project/Site (RE) Name:

Project/Site (RE) Physical Address:

Staple Check In This Space

ATTACHMENT 2A

LARGE CONSTRUCTION SITE NOTICE

FOR THE
Texas Commission on Environmental Quality (TCEQ)
Storm Water Program

TPDES GENERAL PERMIT TXR150000

"PRIMARY OPERATOR" NOTICE

This notice applies to construction sites operating under Part II.E.3. of the TPDES General Permit Number TXR150000 for discharges of storm water runoff from construction sites equal to or greater than five acres, including the larger common plan of development. The information on this notice is required in Part III.D.2. of the general permit. This notice shall be posted along with a copy of the signed Notice of Intent (NOI), as applicable. Additional information regarding the TCEQ storm water permit program may be found on the internet at:

http://www.tceq.state.tx.us/nav/permits/sw_permits.html

Site-Specific TPDES Authorization Number:	
Operator Name:	
Contact Name and Phone Number:	
Project Description: *Physical address or description of the site's location, and estimated start date and projected end date, or date that disturbed soils will be stabilized.*	
Location of Storm Water Pollution Prevention Plan:	

ATTACHMENT 2B

SMALL CONSTRUCTION SITE NOTICE

FOR THE
Texas Commission on Environmental Quality (TCEQ)
Storm Water Program
TPDES GENERAL PERMIT TXR150000

The following information is posted in compliance with **Part II.E.2.** of the TCEQ General Permit Number TXR150000 for discharges of storm water runoff from small construction sites. Additional information regarding the TCEQ storm water permit program may be found on the internet at:

http://www.tceq.state.tx.us/nav/permits/wq_construction.html

Operator Name:	
Contact Name and Phone Number:	
Project Description: *Physical address or description of the site's location, estimated start date and projected end date, or date that disturbed soils will be stabilized*	
Location of Storm Water Pollution Prevention Plan:	

For Small Construction Activities Authorized Under Part II.E.2. (Obtaining Authorization to Discharge) the following certification must be completed:

I _____ (Typed or Printed Name Person Completing This Certification) certify under penalty of law that I have read and understand the eligibility requirements for claiming an authorization under Part II.E.2. of TPDES General Permit TXR150000 and agree to comply with the terms of this permit. A storm water pollution prevention plan has been developed and will be implemented prior to construction, according to permit requirements. A copy of this signed notice is supplied to the operator of the MS4 if discharges enter an MS4. I am aware there are significant penalties for providing false information or for conducting unauthorized discharges, including the possibility of fine and imprisonment for knowing violations.

Signature and Title_____ Date _____

_____*Date Notice Removed*
____*MS4 operator notified per Part II.F.3.*

ATTACHMENT 3

TPDES OPERATOR'S INFORMATION

Owner's Name and Address: City of _____

Mr. _____
(City Official)

_____

Address: _____

_____

_____

Phone: _____

Contractors' Names and Addresses:

General Contractor: _____

_____

_____

_____

Telephone: _____

Site Superintendent: _____

_____

_____

_____

Telephone: _____

Erosion Control and
Maintenance Inspection: _____

_____

_____

_____

Telephone: _____

Subcontractors' Names and Addresses:

_____ _____

_____ _____

_____ _____

_____ _____

Phone: _____ Phone: _____

Note: Insert name, address, and telephone number of person or firms

ATTACHMENT 4

CONTRACTOR'S / SUBCONTRACTOR'S

CERTIFICATION FOR TPDES PERMITTING

I certify under penalty of law that I understand the terms and conditions of the general Texas Pollutant Discharge Elimination System (TPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

ATTACHMENT 5

EPA NPDES Construction Inspection Form

The following inspection is being performed in compliance with Part 3.10. of the NPDES Region 6 Storm Water Construction General Permit [68 FR 39087, July 7, 2003]. Qualified personnel (provided by the permittee or cooperatively by multiple permittees) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, placement and effectiveness of structural control measures, and locations where vehicles enter or exit the site. Inspections shall be performed either once every 7 days (this option not available in New Mexico per Part 9.C.1.c.) or once every 14 days and within 24 hours of the end of a storm event of 0.5 inches or greater. Where sites have been temporarily stabilized, runoff is unlikely due to winter conditions, or during seasonal arid periods in arid areas (0-10 inches of rainfall annually) and semi-arid areas (10-20 inches annually) such inspections shall be conducted at least once every month. This form is primarily intended for use with construction projects in New Mexico. Permittees on Indian Country lands in Texas, Oklahoma, Louisiana and Arkansas and some oil and gas facilities in Texas and Oklahoma may use this form if they are eligible for this permit and EPA is their NPDES permitting authority. Other facilities need to check with their NPDES authority before using this form.

If you do not know your NPDES Permit Number, contact the NOI Processing Center at 866-352-7755. This form was prepared as an example and it is not a required form for use with the permit. Alternative forms may be used if they contain all of the required information as set forth in the permit. This form and additional information regarding the NPDES Region 6 storm water program may be found on the Internet at www.epa.gov/region6/6en/w/formsw.htm. Any person with a complaint about the operation of this facility in regards to this permit should contact EPA Region 6 at (214)665-8060.

Permit Number(s) covered by this inspection (e.g., owners, developers, general contractor, builders).	
Signature and Certification in accordance with Appendix G, Section 11 of the permit.	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. (Clean Water Act, 33 U.S.C. 1251 et seq.)
Date of Inspection.	
Inspector Name.	
Is there a copy of the permit language with the SWPPP?	❑ **Yes** ❑ **No**
Is the inspector qualified and are the qualifications documented in the SWPPP?	❑ **Yes** ❑ **No**
Is an NPDES storm water construction sign posted at the entrance for all permittees?	❑ **Yes** ❑ **No**

You may want to use EPA Region 6 construction checklist to assure components of the SWPPP are complete. This form, the construction sign, and the checklist are available on the Region 6 NPDES Storm Water Forms and Documents web page which may be found on the internet at http://www.epa.gov/earth1r6/6en/w/formsw.htm In addition to the checklist, you should provide a narrative (see next page) on the existing Best Management Practices and Structural Controls found during each inspection. Any problems identified in an inspection should be corrected within 7 days. The inspection should cover all components of the SWPPP and all potential pollutants. While eroded soil is the primary pollutant of concern, do not forget to inspect for other pollutant sources such as fuel tanks, paints, solvents, stabilization materials, concrete hardner, batch plants, and construction debris. The inspector will need to update the SWPPP to reflect findings of the inspection. The site map should be updated after an inspection to show controls that have been added or removed, to ensure the site map is kept current in accordance with Part 3.11.A. of the permit.

July 29, 2003

Narrative Findings of the inspection:

Observations should include any findings of Best Management Practices or controls that are not in accordance with the SWPPP. If a control is not in place or failed, observe the reason why. A control removed temporarily for work is not necessarily a violation if properly recorded in the SWPPP. If it has been removed, record why it was removed and, if applicable, when it will be reinstalled. If the control has failed, observe the conditions so a conclusion may be made as to wether the control failed for improper maintenance or improper design. The qualified inspector will know when a failed control is inadequate and should be replaced by an improved control mechanism. Qualified inspectors are to have authority to make changes to the SWPPP to assure compliance. Controls that have not been installed should be given a reason why they are not installed and/or a scheduled date for installation if they are designed for a later phase of construction. After the inspection, the SWPPP and its site map should be updated to reflect current conditions of controls and Best Management Practices at the time of the inspection. This includes removing uninstalled controls from the site map or otherwise denoting on the site map if they are no longer installed if the controls have been removed because they are no longer necessary (e.g., stabilization has been achieved in that area).

Part 3.10.G. of the permit: For each inspection required above, you must complete an inspection report. At a minimum, the inspection report must include: 1. The inspection date; 2. Names, titles, and qualifications of personnel making the inspection; 3. Weather information for the period since the last inspection (or since commencement of construction activity if the first inspection) including a best estimate of the beginning of each storm event, duration of each storm event, approximate amount of rainfall for each storm event (in inches), and whether any discharges occurred; 4. Weather information and a description of any discharges occurring at the time of the inspection; 5. Location(s) of discharges of sediment or other pollutants from the site; 6. Location(s) of BMPs that need to be maintained; 7. Location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location; 8. Location(s) where additional BMPs are needed that did not exist at the time of inspection; and 9. Corrective action required including any changes to the SWPPP necessary and implementation dates.

July 29, 2003

ATTACHMENT 6

EROSION CONTROL CONTRACTOR'S

CERTIFICATION FOR INSPECTION AND MAINTENANCE

I certify under penalty of law that I understand the terms and conditions of the general Texas Pollutant Discharge Elimination System (TPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

Signature: _____

Name: (printed or typed) _____

Title: _____

Company _____

Address: _____

_____

Date: _____

ATTACHMENT 7

**Notice of Termination (NOT)
for Authorizations under
TPDES General Permit TXR150000**

TCEQ Office Use Only
Permit No.:
RN:
CN:

Reset Form

Sign up now for on line NOT at http://www.tceq.state.tx.us/permitting/steers/steers.html
Get your NOT Confirmation letter immediately after submitting the on line NOT form.

What is the permit number to be terminated?
Processing will be delayed without the permit number. **TXR15**_____

A. OPERATOR (applicant)

1. What is the Customer Number (CN) issued to this entity? **CN**_____
2. What is the full Legal Name of the current permittee?

This must be the current permittee of the permit to be terminated.

3. What is the applicant's mailing address as recognized by the **US Postal Service**?

Address:	Suite No./Bldg. No./Mail Code:	
City:	State:	ZIP Code:
Country Mailing Information (if outside USA).	Country Code:	Postal Code:

4. Phone No.: ( )	Extension:
5. Fax No.: ( )	E-mail Address:

B. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

1. What is the TCEQ Issued RE Reference Number (RN)? **RN**_____
2. Name of Project or Site as currently permitted):

(example: phase and name of subdivision or name of project that's unique to the site)

3. Physical Address of Project or Site as currently permitted: (enter in spaces below)

Street Number:	Street Name:	
City:	ZIP Code:	County (Counties if >1):

4. If no physical address (Street Number & Street Name), provide the written location access description to the site:

C. REASON FOR TERMINATION

Check the reason for termination:

- ☐ Final stabilization has been achieved on all portions of the site that are the responsibility of the Operator and all silt fences and other temporary erosion controls have either been removed, or scheduled for removal as defined in the SWP3.
- ☐ Another permitted Operator has assumed control over all areas of the site that have not been finally stabilized, and temporary erosion controls that have been defined in the SWP3 have been transferred to the new Operator.
- ☐ The activity is now authorized under an alternate TPDES permit.
- ☐ The activity never began at this site that is regulated under the general permit.

D. CERTIFICATION

I, _____ _____
Typed or printed name Title

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I further certify that I am authorized under **30 Texas Administrative Code §305.44** to sign and submit this document, and can provide documentation in proof of such authorization upon request.

Signature:_____ Date:_____
(Use blue ink)

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ATTACHMENT 7

Notice of Termination (NOT) for Authorizations under TPDES General Permit TXR150000 General Information and Instructions

GENERAL INFORMATION

Where to Send the Notice of Intent (NOI):

BY REGULAR U.S. MAIL	BY OVERNIGHT/EXPRESS MAIL
Texas Commission on Environmental Quality	Texas Commission on Environmental Quality
Storm Water Processing Center (MC228)	Storm Water Processing Center (MC228)
P.O. Box 13087	12100 Park 35 Circle
Austin, TX 78711-3087	Austin, TX 78753

TCEQ Contact list:

Application Processing Questions relating to the status and form requirements:	512/239-4671
Technical Questions relating to the general permit:	512/239-4671
Environmental Law Division:	512/239-0600
Records Management for obtaining copies of forms submitted to TCEQ:	512/239-0900
Information Services for obtaining reports from program data bases (as available):	512/239-DATA (3282)
Financial Administration's Cashier's office:	512/239-0357 or 512/239-0187

Notice of Termination Process:

A Notice of Termination is **effective on the date postmarked for delivery to TCEQ**.
When your NOT is received by the program, the form will be processed as follows:

1. **Administrative Review:** The form will be reviewed to confirm the following:
   - the permit number is provided
   - the permit is active and has been approved
   - the entity terminating the permit is the current permittee
   - the site information matches the original permit record
   - the form has the required original signature with title and date

2. **Notice of Deficiency:** If an item is incomplete or not verifiable as indicated above, a phone call will be made to the applicant to clear the deficiency. A letter will not be sent to the permittee if unable to process the form.

3. **Confirmation of Termination:** A Notice of Termination Confirmation letter will be mailed to the operator.

General Permit (Your Permit)
Coverage under the general permit begins **48 hours after a completed NOI is postmarked for delivery to** the TCEQ. You should have a copy of your general permit when submitting your application. You may view and print your permit for which you are seeking coverage, on the TCEQ web site www.tceq.state.tx.us

General Permit Forms
The Notice of Intent (NOI), Notice of Termination (NOT), and Notice of Change (NOC) with instructions are available in Adobe Acrobat PDF format on the TCEQ web site www.tceq.state.tx.us.

Change in Operator
An authorization under the general permit is not transferable. If the operator or owner of the regulated entity changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted not later than 10 days prior to the change in Operator status.

TCEQ Central Registry Core Data Form
The Core Data Form has been incorporated into this form. **Do not send a core data form to TCEQ.**

After final acknowledgment of coverage under the general permit, the program will assign a Customer Number (CN) and Regulated Entity Number (RN). For Construction Permits, a new RN will be assigned for each Notice of Intent filed with TCEQ, since construction project sites can overlap with other Customers. The RN assigned to your construction project will not be assigned to any other TCEQ authorization.

You can find the information on the Central Registry web site at https://www6.tceq.state.tx.us/epay/. You can search by the Regulated Entity (RN), Customer Number (CN) or Name (Permittee), or by your permit number under the search field labeled "Additional ID" Capitalize all letters in the permit number.

ATTACHMENT 7

The Customer (Permittee) is responsible for providing consistent information to the TCEQ, and for updating all CN and RN data for all authorzations as changes occur. For General Permits, a Notice of Change form must be submitted to the program area.

Annual Water Quality Fee: This fee is assessed to operators with an active authorization under the general permit on September 1 of each year. The operator will receive an invoice for payment of the annual fee in November of each year. The payment will be due 30 days from the invoice date. A 5% penalty will be assessed if the payment is received by TCEQ after the due date. Annual fee assessments cannot be waived as long as the authorization under the general permit is active on September 1.

It's important for the operator to submit a **Notice of Termination** (NOT) when coverage under the general permit is no longer required. A NOT is effective on the postmarked date of mailing the form to TCEQ. It is recommended that the NOT be mailed using a method that documents the date mailed and received by TCEQ.

- Mailed Payments:

You must return your payment with the billing coupon provided with the billing statement.

- ePAY Electronic Payment:

Go to https://www6.tceq.state.tx.us/epay/
You must enter your account number provided at the top portion of your billing statement. Payment methods include Mastercard, Visa, and electronic check payment (ACH). A transaction over $500 can only be made by ACH.

INSTRUCTIONS FOR FILLING OUT THE NOT FORM

A. OPERATOR (current permittee.)

1. TCEQ Issued Customer Number (CN)

2. Legal Name of Operator
The operator must be the same entity as previously submitted on the original Notice of Intent for the permit number provided.

3. Operator Mailing Address
Provide a complete mailing address for receiving mail from the TCEQ. Update the address if different than previously submitted in the Notice of Intent or Notice of Change.

4. Phone Number, Fax Number, and E-mail Address
Provide updated contact information.

B. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

1. Regulated Entity Reference Number (RN)

2. Site/Project Name/Regulated Entity
Provide the name of the site as previously submitted in the Notice of Intent for the permit number provided.

3. Site/Project (RE) Physical Address
Provide the physical address or location access description as previously submitted for the permit number provided.

C. REASON FOR TERMINATION

Indicate the reason for terminating the permit by checking one of the options. If the reason is not listed then provide an attachment that explains the reason for termination.

Please read your general permit carefully to determine when to terminate your permit. Permits will not be reactivated after submitting a termination form. The termination is effective on the date postmarked for delivery to TCEQ.

D. CERTIFICATIONS

The certification must bear an original signature of a person meeting the signatory requirements specified under 30 Texas Administrative Code (TAC) §305.44.

IF YOU ARE A CORPORATION:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(1) (see below). According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

IF YOU ARE A MUNICIPALITY OR OTHER GOVERNMENT ENTITY:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(3) (see below). According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statute(s) under which your government entity was formed. An NOI or similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to

ATTACHMENT 7

§305.44(a)(3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the Texas Commission on Environmental Quality's Environmental Law Division at 512/239-0600.

30 Texas Administrative Code
§305.44. Signatories to Applications.

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

END OF SECTION

SECTION 01566

SOURCE CONTROLS FOR EROSION AND SEDIMENTATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Description of erosion and sediment control and other control-related practices which shall be utilized during construction activities.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this Section. Include payment in unit price for related work.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than site work specifically directed by the Owner's Representative to allow soil testing and surveying.

B. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately by the Contractor.

C. The Contractor shall be responsible for collecting, storing, hauling, and disposing of spoil, silt, and waste materials as specified in this or other Specifications and in compliance with applicable federal, state, and local rules and regulations.

D. Contractor shall conduct all construction operations under this Contract in conformance with the erosion control practices described in the Drawings and this Specification.

E. The Contractor shall install, maintain, and inspect erosion and sediment control measures and practices as specified in the Drawings and in this or other Specifications.

3.02 TOPSOIL PLACEMENT FOR EROSION AND SEDIMENT CONTROL SYSTEMS

A. When topsoil is specified as a component of another Specification, the Contractor shall conduct erosion control practices described in this Specification during topsoil placement operations.

1. When placing topsoil, maintain erosion and sediment control systems, such as swales, grade stabilization structures, berms, dikes, silt fences, and sediment basins.

2. Maintain grades which have been previously established on areas to receive topsoil.

3. After the areas to receive topsoil have been brought to grade, and immediately prior to dumping and spreading the topsoil, loosen the subgrade by disking or by scarifying to a depth of at least 2 inches to permit bonding of the topsoil to the subsoil. The contractor is responsible for the grading plan and fill permit, if required.

3.03 DUST CONTROL

A. Implement dust control methods to control dust creation and movement on construction sites and roads and to prevent airborne sediment from reaching receiving streams or storm water conveyance systems, to reduce on-site and off-site damage, to prevent health hazards, and to improve traffic safety.

B. Control blowing dust by using one or more of the following methods:

1. Mulches bound with chemical binders.

2. Temporary vegetative cover.

3. Tillage to roughen surface and bring clods to the surface.

4. Irrigation by water sprinkling.

5. Barriers using solid board fences, burlap fences, crate walls, bales of hay, or similar materials.

C. Implement dust control methods immediately whenever dust can be observed blowing on the project site.

3.04 KEEPING STREETS CLEAN

A. Keep streets clean of construction debris and mud carried by construction vehicles and equipment. If necessary to keep the streets clean, install stabilized construction exits at construction, staging, storage, and disposal areas. A vehicle/equipment wash

area (stabilized with coarse aggregate) may be installed adjacent to the stabilized construction exit, as needed. Release wash water into a drainage swale or inlet protected by erosion and sediment control measures. Construction exit and wash areas are specified in Section 01569 - Stabilized Construction Exit.

B. In lieu of or in addition to stabilized construction exits, shovel or sweep the pavement to the extent necessary to keep the street clean. **Water hosing or sweeping of debris and mud off of the street into adjacent areas is not allowed.**

3.05 EQUIPMENT MAINTENANCE AND REPAIR

A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose. Locate such areas so that oils, gasoline, grease, solvents, and other potential pollutants cannot be washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid as well as solid waste. Clean and inspect maintenance areas daily.

B. On a construction site where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.06 WASTE COLLECTION AND DISPOSAL

A. Contractor shall formulate and implement a plan for the collection and disposal of waste materials on the construction site. In plan, designate locations for trash and waste receptacles and establish a collection schedule. Methods for ultimate disposal of waste shall be specified and carried out in accordance with applicable local, state, and federal health and safety regulations. Make special provisions for the collection and disposal of liquid wastes and toxic or hazardous materials. Contractor is responsible for taking necessary precautions to prevent scattering of debris by winds.

B. Keep receptacles and waste collection areas neat and orderly to the extent possible. Waste shall not be allowed to overflow its container or accumulate from day-to-day. Locate trash collection points where they will least likely be affected by concentrated storm water runoff.

3.07 WASHING AREAS

A. Vehicles such as concrete delivery trucks or dump trucks and other construction equipment shall not be washed at locations where the runoff will flow directly into a watercourse or storm water conveyance system. Designate special areas for washing vehicles. Locate these areas where the wash water will spread out, or where the runoff can be collected in a temporary holding or seepage basin. Beneath wash areas

construct a gravel or rock base to minimize mud production. Dispose of washout in a legal manner at end of project.

3.08 STORAGE OF CONSTRUCTION MATERIALS AND CHEMICALS

A. Isolate sites where chemicals, cements, solvents, paints, or other potential water pollutants are stored in areas where they will not cause runoff pollution.

B. Store toxic chemicals and materials, such as pesticides, paints, and acids in accordance with manufacturers' guidelines. Protect groundwater resources from leaching by placing a plastic mat, packed clay, tar paper, or other impervious materials on any areas where toxic liquids are to be opened and stored.

3.09 DEMOLITION AREAS

A. Demolition activities which create large amounts of dust with significant concentrations of heavy metals or other toxic pollutants shall use dust control techniques to limit transport of airborne pollutants. However, water or slurry used to control dust contaminated with heavy metals or toxic pollutants shall be retained on the site and shall not be allowed to run directly into watercourses or storm water conveyance systems. Methods of ultimate disposal of these materials shall be carried out in accordance with applicable local, state, and federal health and safety regulations.

3.10 PESTICIDES

A. Use and store pesticides during construction in accordance with manufacturers' guidelines and with local, state, and federal regulations. Avoid overuse of pesticides which could produce contaminated runoff. Take great care to prevent accidental spillage. Never wash pesticide containers in or near flowing streams or storm water conveyance systems.

END OF SECTION

SECTION 01567

FILTER FABRIC FENCE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of erosion and sediment control filter fabric fences used during construction and until final development of the site. The purpose of filter fabric fences is to contain pollutants from overland flow. Filter fabric fences are not for use in channelized flow areas.

1.02 UNIT PRICES

A. Filter fabric fence will be measured by the linear foot, or lump sum as specified in the bid proposal for the project, of completed and accepted filter fabric fence between the limits of the beginning and ending of wooden stakes. Filter fabric fence, measured as stated, will be paid for at the unit price bid for Filter Fabric Fence, Complete in Place.

B. Payment for filter fabric fence will include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to protection of trees, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, and removal of erosion and sediment control systems at the end of construction.

1.03 SUBMITTALS

A. Manufacturer’s catalog sheets and other product data on geotextile fabric.

PART 2 P R O D U C T S

2.01 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric shall have a grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140.

C. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. Provide erosion and sediment control systems at the locations shown on Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than site work specifically directed by the Owner's Representative to allow soil testing and surveying.

C. Regularly inspect and repair or replace damaged components of filter fabric fences as specified in this Section. Unless otherwise directed, maintain the erosion and sediment control systems until the project area stabilization is accepted by the Owner. Remove erosion and sediment control systems promptly when directed or approved by the Owner's Representative. Discard removed materials off site.

D. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at a location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

E. Conduct all construction operations under this Contract in conformance with the erosion control practices described in Section 01566 - Source Controls for Erosion and Sedimentation.

3.02 CONSTRUCTION METHODS

A. Provide filter fabric fence systems in accordance with the Drawing detail for Filter Fabric Fences. Filter fabric fences shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the filter fabric to 2-inch by 2-inch wooden stakes spaced a maximum of 3 feet apart and embedded a minimum of 8 inches. If filter fabric is factory preassembled with support netting, then maximum spacing allowable is 8 feet. Install wooden stakes at a slight angle toward the source of anticipated runoff.

C. Trench in the toe of the filter fabric fence with a spade or mechanical trencher as shown on the Drawings. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.

E. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

F. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately. Remove sediment deposits when silt reaches a depth one-third the height of the fence or 6 inches, whichever is less.

END OF SECTION

SECTION 01568

REINFORCED FILTER FABRIC BARRIER

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of reinforced filter fabric barriers for erosion and sediment control used during construction and until the final development of the site. Reinforced filter fabric barriers are used to retain sedimentation in channelized flow areas.

1.02 UNIT PRICES

A. Filter fabric barrier will be measured by the linear foot of completed and accepted filter fabric barrier between the limits of the beginning and ending fence posts. Filter fabric barrier, measured as stated, will be paid for at the unit price bid for Reinforced Filter Fabric Barrier, Complete in Place.

B. Payment for filter fabric barrier will include and be full compensation for all labor, equipment, materials, supervision, and incidental expenses for construction of these items, complete in place, including, but not limited to protection of trees, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, and removal of erosion and sediment control systems at the end of construction.

1.03 SUBMITTALS

A. Manufacturer's catalog sheets and other product data on geotextile fabrics.

PART 2 P R O D U C T S

2.01 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric shall have a minimum grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140.

C. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.

2.02 FENCING

A. Provide woven galvanized steel wire fence with minimum thickness of 14 gauge and a maximum mesh spacing of 6 inches.

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. Provide erosion and sediment control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner's Representative to allow soil testing and surveying.

C. Regularly inspect and repair or replace damaged components of the reinforced filter fabric barrier as specified in this Section. Unless otherwise directed, maintain the erosion and sediment control systems until the project area stabilization is accepted by the Owner. Remove erosion and sediment control systems promptly when directed by the Owner's Representative. Discard removed materials off site.

D. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at a location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

E. Conduct all construction operations under this Contract in conformance with the erosion control practices described in Section 01566 - Source Controls for Erosion and Sedimentation.

3.02 CONSTRUCTION METHODS

A. Provide filter fabric barriers in accordance with the Drawing detail for Reinforced Filter Fabric Barrier. Filter fabric barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the woven wire support to 2-inch by 2-inch wooden stakes spaced a maximum of 6 feet apart and embedded a minimum of 8 inches. Install wooden stakes at a slight angle toward the source of the anticipated runoff.

C. Trench in the toe of the filter fabric barrier with a spade or mechanical trencher as shown on the Drawings. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Securely fasten the filter fabric material to the woven wire with tie wires.

E. Reinforced filter fabric barrier shall have a height of 18 inches.

F. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

G. Inspect the reinforced filter fabric barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately. Remove sediment deposits when silt reaches a depth one-third the height of the barrier or 6 inches, whichever is less.

END OF SECTION

SECTION 01569

STABILIZED CONSTRUCTION EXIT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of erosion and sediment control for stabilized construction exits used during construction and until final development of the site.

1.02 SUBMITTALS

A. Manufacturer's catalog sheets and other product data on geotextile fabric.

B. Sieve analysis of aggregates conforming to requirements of this Specification.

1.03 UNIT PRICES

A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.

PART 2 P R O D U C T S

2.01 GEOTEXTILE FABRIC

A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric shall have grab strength of 270 psi in any principal direction (ASTM D-4632), and the equivalent opening size between 50 and 140.

C. Both the geotextile and threads shall be resistant to chemical attack, mildew, and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable life at a temperature range of 0ºF to 120ºF.

D. Representative Manufacturers: Mirafi, Inc., or equal.

2.02 COARSE AGGREGATES

A. Coarse aggregate shall consist of crushed stone, gravel, crushed concrete, or a combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, rebar, shale, soft or flaky materials, or organic and injurious matter.

B. Coarse aggregates shall conform to the following gradation requirements.

Sieve Size (Square Mesh)	Percent Retained (By Weight)
2-1/2"	0
2"	0 – 20
1-1/2"	15 – 50
¾"	60 – 80
No. 4	95 - 100

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. If necessary to keep the street clean of mud carried by construction vehicles and equipment, Contractor shall provide stabilized construction roads and exits at the construction, staging, parking, storage, and disposal areas. Such erosion and sediment controls shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner's Representative to allow soil testing and surveying.

C. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by the Owner's Representative to remove and discard the existing system.

D. Regularly inspect and repair or replace components of stabilized construction exits. Unless otherwise directed, maintain the stabilized construction roads and exits until the project is accepted by the City. Remove stabilized construction roads and exits

promptly when directed by the Owner's Representative. Discard removed materials off site.

E. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at a permitted location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

F. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.

G. Conduct all construction operations under this Contract in conformance with the erosion control practices described in the relevant sections of these specifications.

3.02 CONSTRUCTION METHODS

A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.

B. Provide stabilized construction exits, and truck washing areas when approved by Owner's Representative, of the sizes and locations where shown on Drawings or as specified in this Section.

C. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas which drain into a drainage system protected by erosion and sediment control measures.

D. Details for stabilized construction exit may be shown on the Drawings. Construction of all other stabilized areas shall be to the same requirements. Roadway width shall be at least 14 feet for one-way traffic and 20 feet for two-way traffic and shall be sufficient for all ingress and egress. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of 14 days to minimize damage potential.

E. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering public right-of-way, receiving stream or storm water conveyance system.

F. The stabilized areas shall be inspected and maintained daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged control measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.

G. The length of the stabilized area may be as shown on the Drawings, but not less than 50 feet. The thickness shall not be less than 8 inches. The width shall not be less than full width of all points of ingress or egress.

H. Stabilization for other areas shall have the same coarse aggregate, thickness, and width requirements as the stabilized construction exit, except where shown otherwise on the Drawings.

I. Stabilized area may be widened or lengthened to accommodate truck washing area when authorized by Owner's Representative.

J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by the Owner's Representative. These methods include the following:

1. Cement-Stabilized Soil - Compacted cement-stabilized soil or other fill material in an application thickness of at least 8 inches.

2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge-to-edge and across support wooden beams which are placed on top of existing soil in an application thickness of at least 6 inches.

3. Steel Mats - Perforated mats placed across perpendicular support members.

END OF SECTION

SECTION 01570

TRAFFIC CONTROL AND REGULATION

PART 1 G E N E R A L

.1 SECTION INCLUDES

A. Requirements for signs, signals, control devices, flares, lights and traffic signals, as well as construction parking control, designated haul routes and bridging of trenches and excavations.

B. Qualifications and requirements for use of flagmen.

.2 SUBMITTALS

A. Make submittals in accordance with Section 01300 - Submittals

.3 UNIT PRICES

A. Measurement and payment is on a unit of time or lump sum basis for traffic control and regulation, including obtaining approvals by governing authorities, preparation and submittal of traffic control plan if different than shown on Drawings, and subsequent approval from Owner and any other entity prior to commencing work in their right-of-way, provision of traffic control devices, barrels, barricades, control panels, signage including arrow boards as necessary for the project, relocation of traffic signs and control devices as necessary, relocating and replacing existing signs and provision of equipment and personnel as necessary to protect the work and the public in accordance with the Texas Manual of Uniform Traffic Control Devices (TxMUTCD). The amount invoiced shall be determined based on the approved schedule of values for traffic control and regulation.

B. No separate measurement will be made for flaggers as required for the Project. Flaggers shall be considered incidental to the traffic control and regulation bid item.

.4 FLAGMEN

A. Use only flagmen who are off-duty, regularly employed, uniformed peace officers when specified in the Special Conditions. The Contractor shall also utilize certified flagmen at locations approved by the Owner or Owner’s Representative.

B. Use flagmen to control, regulate and direct an even flow and movement of vehicular and pedestrian traffic, for periods of time as may be required to provide for public safety and convenience, where:

1. Where multi-lane vehicular traffic must be diverted into single-lane vehicular traffic.

2. Where vehicular traffic must change lanes abruptly.

3. Where construction equipment either enters or crosses vehicular traffic lanes and walks.

4. Where construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalks.

5. Where traffic regulation is needed due to rerouting of vehicular traffic around the work site.

6. Where construction activities might affect public safety and convenience.

C. The use of flagmen is for the purpose of assisting in the regulation of traffic flow and movement, and does not in any way relieve the contractor of full responsibility for taking such other steps and provide such other flagmen or personnel as the Contractor may deem necessary to protect the work and the public, and does not in any way relieve the Contractor of his responsibility for any damage for which he would otherwise be liable.

Flagmen shall be used and maintained at such points for such periods of time as may be required to provide for the public safety and convenience of travel.

PART 2 P R O D U C T S

.1 SIGNS, SIGNALS, AND DEVICES

A. Comply with Texas State Manual on Uniform Traffic Control Devices (latest revision).

B. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.

PART 3 E X E C U T I O N

.1 PUBLIC ROADS

A. Abide by laws and regulations of governing authorities when using public roads. If the Contractor's work requires that public roads be temporarily impeded or closed, approvals shall be obtained from governing authorities and permits paid for before starting any work. Coordinate activities with the Owner's Representative.

B. Give Owner's Representative one-week notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.

C. Notify police department, fire department, and local schools, churches, and businesses in writing a minimum of five business days prior to beginning work.

D. Contractor shall maintain at all times a 10-foot-wide all-weather lane adjacent to work areas which shall be kept free of construction equipment and debris and shall be for the use of emergency vehicles, or as otherwise provided in the traffic control plan.

E. Contractor shall not obstruct the normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by the Owner's Representative.

F. Contractor shall maintain local driveway access to residential and commercial properties adjacent to work areas at all times unless approved. Use all-weather materials approved by Owner's Representative to maintain temporary driveway access to commercial and residential driveways. The Contractor shall also give special consideration to maintain access by constructing temporary driveway pavement for schools, apartment complex, day care facilities, hospitals, clinics, retirement and assisted living facilities.

G. To minimize the inconvenience to the public and to maintain better quality control, the total of all demolition, construction and testing activities cannot exceed 2-lanes in one direction (includes parking lane) for a total length of one-thousand (1,000) linear feet or three City Blocks in length, whichever is less.

H. Cleanliness of Surrounding Streets:

1. Keep streets used for entering or leaving the job area free of excavated material, debris, and any foreign material resulting from construction operations in compliance with applicable ordinances.

I. Remove existing signage and striping that conflict with construction activities or that may cause driver confusion.

J. Provide safe access for pedestrians along major cross streets.

K. Alternate closures of cross streets so that two adjacent cross streets are not closed simultaneously.

L. Do not close more than two consecutive esplanade openings at a time without prior approval from Owner's Representative.

.2 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the Owners's operations.

B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain

vehicular access to and through parking areas.

C. Prevent parking on or adjacent to access roads or in non-designated areas.

.3 FLARES AND LIGHTS

A. Provide lights during hours of low visibility to delineate traffic lanes and to guide traffic.

.4 HAUL ROUTES

A. Utilize haul routes designated by owner, authorities or shown on the Drawings for construction traffic.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

.5 TRAFFIC SIGNS AND SIGNALS

A. Construct all necessary traffic control devices including but not limited to loop detectors, traffic signal conduits, traffic signal wiring and cross walk signals as shown on the plan drawings.

B. Install traffic control devices at approaches to the site and on site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

C. Relocate traffic signs and appurtenances as Work progresses to maintain effective traffic control.

D. Unless otherwise approved by Owner's Representative, provide driveway signs with the name of business that can be accessed from the particular cross-over. Two signs will be required for each cross-over.

E. Replace existing traffic control devices in the project area.

F. Owner's Representative may direct Contractor to make adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the Owner.

G. Repair or replace signal control devices, detectors or cables where damage occurred due to Contractors construction efforts or operation of equipment related to paving repairs or removal.

.6 BRIDGING TRENCHES AND EXCAVATIONS

A. Whenever necessary, bridge trenches and excavation to permit an unobstructed flow of traffic. Provide steel plates that can be laid across construction areas and major drives of commercial businesses.

B. Secure bridging against displacement by using adjustable cleats, angles, bolts or other devices whenever bridge is installed:

1. On an existing bus route;

2. When more than five percent of daily traffic is comprised of commercial or truck traffic;

3. When more than two separate plates are used for the bridge; or

4. When bridge is to be used for more than five consecutive days.

C. Install bridging to operate with minimum noise.

D. Adequately shore the trench or excavation to support bridge and traffic.

E. Extend steel plates used for bridging a minimum of one foot beyond edges of trench or excavation. Use temporary paving materials (premix) to feather edges of plates to minimize wheel impact on secured bridging.

F. Use steel plates of sufficient thickness to support H-20 loading, truck or lane, that produces maximum stress.

.7 REMOVAL

A. Remove equipment and devices when no longer required.

B. Repair damage caused by installation.

C. Remove post settings to a depth of 2 feet.

.8 MAINTENANCE OF EQUIPMENT AND MATERIAL

A. Designate individual to be responsible for maintenance of traffic handling around construction area. This individual must be accessible at all times to immediately correct any deficiencies in equipment and materials used to handle traffic, such as missing, damaged, or obscured signs, drums, barricades, or pavement markings. Give name, address and telephone number of designated individual to the Owner's Representative.

B. Make daily inspections of signs, barricades, drums, lamps and temporary pavement markings to verify that these are visible, and in good working order, and in conformance with TxDOT or any other entity. When not in conformance

immediately bring equipment and materials into conformance by replacement, repair, cleaning, relocation, and/or realignment.

C. Keep all equipment and materials, especially signs and pavement markings, clean and free of dust, dirt, grime, oil, mud or debris.

END OF SECTION

SECTION 01578

DEWATERING AND DRAINAGE

PART 1 G E N E R A L

1.01 SCOPE OF WORK

A. Design, furnish, install, operate, monitor, maintain, and remove a temporary dewatering system as required and lower and control water levels below subgrades of excavation to permit construction in dry conditions.

B. Furnish, maintain, and remove temporary surface water control measures adequate to drain and remove surface water entering excavations.

C. Collect and properly dispose of all discharge water from the dewatering and drainage systems in accordance with the provision of Section 01564 – Waste Material Disposal. No waste material shall be disposed to the City Storm Sewer, Sanitary Sewer, any location in the City Right of Way, or the Roadway.

D. No contaminated water or solids including oil sheens shall be disposed to the City systems including storm sewer, roadway or sanitary sewer. No dewatering or drainage shall be disposed to the City Sanitary Sewer. All dewatering and drainage shall be properly disposed to the City Storm Sewer or the Roadway in compliance with:

- 01563-Control of Ground Water and Surface Water
- 01565-TPDES Requirements
- 01566-Source Controls for Erosion and Sedimentation
- 01567-Filter Fabric Fence
- 01568-Reinforced Filter Fabric Barrier
- 01569-Stabilized Construction Exit

1.02 MEASUREMENT AND PAYMENT (**NO SEPARATE PAY**)

A. No additional payment will be made for dewatering and drainage. Include cost for unit price for work requiring dewatering and drainage.

1.03 CONTRACTOR'S RESPONSIBILITY

A. Design and execution of methods for controlling surface water and groundwater.

B. Repair work that may result from damage to properties, buildings or structures sewers and other utility installations, and/or pavements due to dewatering or surface water control operations.

C. Design review and field monitoring activities be the City shall not relieve the Contractor of his/her responsibilities for the work.

1.04 SUBMITTALS

A. Submit detailed plans of the proposed dewatering method, as specified on 3.03 below.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Pipe for observation wells, if required, shall consist of minimum 1-inch., Schedule 80 PVC pipe and machine slotted PVC well-points, maximum slot size 0.020-in.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Control Surface water and groundwater such that excavation to final grade is made in dry conditions, the bearing soils are maintained undisturbed, and softening and /or instability or disturbance due to the presence or seepage of water does not occur. All construction and backfilling shall proceed during dry conditions and flotation of completed portions of work shall be prohibited.

3.02 SURFACE WATER CONTROL

A. Construct Surface water control measures, including dikes, ditches, sumps and other methods to prevent, as necessary, flow of Surface water into excavations.

3.03 EXCAVATION DEWATERING

A. At all times during construction, furnish and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavation. Excavations shall be kept dry, so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

B. Pipe shall not be laid in water or submerged within 24 hours after being placed.

C. Prevent flotation of the pipe by promptly placing backfill.

D. Dewatering shall at all times be conducted in such a matter as to preserve the natural undisturbed capacity of the subgrade soils at proposed bottom of excavation. If the subgrade of the trench bottom or excavation becomes disturbed due to inadequate drainage, excavate below normal grade as directed by the City Representative and refill with screened gravel at the Contractor’s expense.

E. Evaluate the impact of the anticipated subsurface soil/water condition on the proposed method of excavation and removal of water.

F. Where groundwater level is above the proposed bottom of excavation level, it is expected that some type of pumped dewatering system will be required for pre- drainage of the soils prior to final excavation and for maintaining the lowered

groundwater level until construction has been completed to such an extent that the structure, pipeline or fill will not be floated or otherwise damaged. It is further expected that the type of system, spacing of dewatering units and other details of the work will have to be varied depending on soil/water conditions at a particular location.

G. At least two weeks prior to the start of construction in any areas of anticipated dewatering submit to the City Representative for review, a proposed initial plan for removal of water, method of excavation, and support of the excavation. Do not proceed with construction in any of these areas until the initial plan has been reviewed and commented upon by the City's Representative. It is expected that the initial plan may have to be modified to suit the variable soil/water conditions to be encountered along the route. Dewater and excavate, at all times, in a manner which does not cause loss of ground or disturbance to the pipe bearing soil or soil which supports overlying or adjacent structures.

H. If the method of dewatering does not properly dewater the trench as specified, install groundwater observation wells as directed by the City's Representative and do not place any pipe or structure until the readings obtained from the observation wells indicate that the groundwater has been lowered a minimum of 6 inch below the bottom of the final excavation within the trench limits.

I. Dewatering units used in the work shall be surrounded by suitable filter sand and no fines shall be removed by pumping. Pumping from the dewatering system shall be continuous until pipe or structure is adequately backfilled. Stand-by pumps shall be provided.

J. Water entering the excavation from precipitation or surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sump and pumped from the excavation to maintain a bottom free from standing water.

K. Drainage shall be disposed of in an approved area. Existing or new sanitary sewers shall not be used to dispose of drainage.

END OF SECTION

SECTION 01580

PROJECT IDENTIFICATION SIGNS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Project identification sign description.

B. Installation.

C. Maintenance and removal.

1.02 UNIT PRICES

A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.

B. If changes to project identification signs are requested by the Owner's Representative to keep them current, payment will be made by change order.

C. Skid-mounted signs shall be relocated as directed by the Owner's Representative at no additional cost to the Owner. Post-mounted signs shall be relocated, if directed in writing by the Owner's Representative, at no additional cost to the Owner.

1.03 SYSTEM DESCRIPTION

A. Sign Construction: Project identification signs shall be constructed of new materials and painted new for the project. Construct post-mounted signs as shown on Construction Sign Details.

B. Appearance: Project identification signs shall be maintained to present a clean and neat look throughout the project duration.

C. Sign manufacturer/Maker: Experienced as a professional sign company.

D. Sign Placement: Place signs at locations as directed by the Owner's Representative. The Owner's Representative will provide sign placement instructions at the Pre-construction Meeting.

1. A linear project is one involving paving, overlay, sewer lines, storm drainage, or water mains that run in the right-of-way over a distance. A linear project requires a project identification sign at each end of the construction site.

2. Single Site or Building Projects: Provide one project identification sign.

3. Multiple Sites: Provide one project identification sign at each site.

4. Sign Relocation: As work progresses at each site, it may be necessary to move and relocate project identification signs. Relocate signs as directed in writing by the Owner's Representative.

E. Alternate Skid-mounted Sign Construction: Post-mounted signs are preferred, but skid-mounted signs are allowed, especially for projects with noncontiguous locations where work progresses from one location to another. The skid structure shall be designed to that the sign will withstand a 60-mile-per-hour wind directly to the face or back of the sign. Use stakes, straps, or ballast. Approval of the use of skid-mounted signs shall not release the Contractor from responsibility of maintaining a project identification sign on the project site and shall not make the Owner responsible for the security of such signs.

1.04 SUBMITTALS

A. Submit shop drawings under provisions of relevant Sections of these specifications.

B. Show content, layout, lettering style, lettering size, and colors. Make sign and lettering to scale, clearly indicating condensed lettering, if used.

PART 2 P R O D U C T S

2.01 SIGN MATERIALS

A. Structure and Framing: All sign materials shall be new.

1. Sign Posts: Use 4-inch by 4-inch treated wood posts, sized to fix top of sign at **6 FEET ABOVE GROUND**.

2. Sign Supports and Skid Bracing: 2-inch by 4-inch wood framing material.

3. Skid Members: 2-inch by 6-inch wood framing material.

4. Fasteners:

a. Use galvanized steel fasteners.

b. Use 3/8-inch by 5-1/2-inch button head carriage bolts to attach sign to posts. Secure with nuts and flat head washers at locations as recommended by Sign Manufacturer.

c. Cover button heads with white reflective film or paint to match sign background.

B. Sign and Sign Header: Use medium density overlaid marine plywood, minimum ½-inch thick. Use full-size 4-foot by 8-foot sheets for sign and a single piece for header to minimize joints; do not piece wood to fabricate a sign face.

C. Paint and Primers: White paint used to prime surfaces and to resist weathering shall be an industrial grade, fast-dying, oil-based paint with gloss finish. Paint structural and framing members white on all sides and edges to resist weathering. Paint sign and sign header material white on all sides and edges to resist weathering. Paint all sign surfaces with this weather-protective paint prior to adding any sign paint or adhesive applications.

D. Colors:

1. Follow criteria established by attached Exhibit.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install Project identification signs within 10 calendar days after Date of Commencement.

B. Erect signs where designated by the Owner's Representative at the Pre-construction Meeting or as described in part 1.03 of this Section. Position the sign in such a manner as to be fully visible and readable to the general public.

C. Erect sign level and plumb.

D. If mounted on post, sink posts a mínimum of 30-inches below grade in 10-inch diameter posthole. Stabilize posts with sharp sand or concrete to minimize lateral motion. Leave a mínimum of 8-feet of post above existing grade for mounting of the sign and header.

E. Erect sign so that the top edge of the sign is no higher than 6-feet above existing grade.

3.02 MAINTENANCE AND REMOVAL

A. Keep signs and support clean. Repair deterioration and damage.

B. Remove signs, framing, supports, and foundations to a depth of 2-feet upon completion of Project. Restore the area to a condition equal to or better tan before construction.

END OF SECTION

SECTION 01600

MATERIAL & EQUIPMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Requirements for transportation, delivery, handling, and storage of materials and equipment.

1.02 MEASUREMENT AND PAYMENT

A. Unless indicated as a Bid Item, no separate payment will be made for Work performed under this Section. Include cost in Bid Items for which this work is a component.

B. No payment for stored material will be made unless stipulated or approved by owner.

1.03 PRODUCTS

A. Products: Means material, equipment, or systems forming the Work. Does not include machinery and equipment used for preparation fabrication, conveying and erection of the Work. Products may also include existing materials or components designated for reuse.

B. Do not reuse materials and equipment, designated to be removed, except as specified by the Contract Documents.

C. Provide equipment and components from the fewest number of manufacturers as is practical, in order to simplify spare parts inventory and to allow for maximum interchangeability of components. For multiple components of the same size, type or application, use the same make and model of component throughout the Work.

1.04 TRANSPORTATION

A. Make arrangements for transportation, delivery, and handling of equipment and materials required for timely completion of the Work.

B. Transport and handle products in accordance with instructions.

C. Consign and address shipping documents to the proper party giving name of Project, street number, and City. Shipments shall be delivered to the Contractor.

1.05 DELIVERY

A. Arrange deliveries of products to accommodate the Construction Schedule and in ample time to facilitate inspection prior to installation. Avoid deliveries that cause lengthy delays or overburden of limited storage space.

B. Coordinate deliveries to avoid conflict with Work and conditions at the Project Site and to accommodate the following:

1. Work of other contractors or the Owner.

2. Limitations of storage space.

3. Availability of equipment and personnel for handling products.

4. Owner's use of premises.

C. Have products delivered to the Project Site in manufacturer's original, unopened, labeled containers.

D. Immediately upon delivery, inspect shipment to assure:

1. Product complies with requirements of Contract Documents.

2. Quantities are correct.

3. Containers and packages are intact; labels are legible.

4. Products are properly protected and undamaged.

5. Insure provisions on material safety data sheets (MSDS) are followed.

1.06 PRODUCT HANDLING

A. Coordinate the off-loading of materials and equipment delivered to the Project Site. If necessary to move stored materials and equipment during construction, Contractor shall relocate materials and equipment at no additional cost to the Owner.

B. Provide equipment and personnel necessary to handle products, including those provided by the Owner, by methods to prevent damage to products or packaging.

C. Provide additional protection during handling as necessary to prevent breaking scraping, marring, or otherwise damaging products or surrounding areas.

D. Handle products by methods to prevent over bending or overstressing.

E. Lift heavy components only at designated lifting points.

F. Handle materials and equipment in accordance with Manufacturer's recommendations.

G. Do not drop, roll, or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

1.07 STORAGE OR MATERIAL

A. Store and protect materials in accordance with manufacturer's recommendations and requirements of these Technical Specifications. Control storage of potential water pollutants in compliance with all applicable provisions of all Sections of these specifications.

B. Make necessary provisions for safe storage of materials and equipment. Place loose soil materials, and materials to be incorporated into the Work to prevent damage to any part of the Work or existing facilities and to maintain free access at all times to all parts of the Work and to utility service company installations in the vicinity of the Work.

C. Keep materials and equipment neatly and compactly stored in locations that will cause a minimum of inconvenience to other contractors, public travel, adjoining owners, tenants, and occupants. Arrange storage in a manner to provide easy access to inspection.

D. Provide adequately ventilated, watertight storage facilities with floor above ground level for materials and equipment susceptible to weather damage.

E. Restrict storage to areas available on the construction site for storage of material and equipment as shown on Plans or approved by the Owner's Representative.

F. Provide off-site storage and protection when on-site storage is not adequate.

G. Do not use lawns, grass plots, or other private property for storage purposes without written permission of the owner. Damage to lawns, sidewalks, streets or other improvements shall be repaired or replaced to the satisfaction of the Owner's Representative.

H. Protect stored materials and equipment against loss or damage. Contractor is fully responsible for loss and/or damage of stored material.

I. Store materials in manufacturers' unopened containers.

J. Materials delivered and stored along the line of the Work shall be not closer than 3 feet to any fire hydrant. Public and private drives and street crossings shall be kept open.

K. The total length which materials may be distributed along the route of construction at any one time is specified in Section 01015 – Contractor's Use of Premises.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01630

PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Options for making product or process selections.

B. Procedures for proposing equivalent construction products or processes, including preapproved, and approved products or processes.

1.02 DEFINITIONS

A. Product: Means, materials, equipment, or systems incorporated into the Project. Product does not include machinery and equipment used for production, fabrication, conveying, and erection of the Work. Products may also include existing materials or components designated for re-use.

B. Process: Any proprietary system or method for installing system components resulting in an integral, functioning part of the Work. For this Section, the word Product includes Processes.

1.03 SELECTION OPTIONS

A. Preapproved Products: Construction products of certain manufacturers or suppliers are designated in the Specifications as “preapproved.” Products of other manufacturers or suppliers will not be acceptable for this Project and will not be considered under the submittal process for approving alternate products.

B. Approved Products: Construction products or processes of certain manufacturers or suppliers designated in the Specifications followed by the words "or approved equal." Approval of alternate products or processes not listed in the Specifications may be obtained through provisions in the Special Conditions, and by following the submittal procedures specified in Section 01300 - Submittals. The procedure for approval of alternate products is not applicable to preapproved products.

C. Product Compatibility: To the maximum extent possible, provide products that are of the same type or function from a single manufacturer, make, or source. Where more than one choice is available as a Contractor's option, select a product which is compatible with other products already selected, specified, or in use by the Owner.

1.04 CONTRACTOR'S RESPONSIBILITY

A. The Contractor's responsibility related to product options and substitutions is defined in the Special Conditions.

B. Furnish information the Owner's Representative deems necessary to judge equivalency of the alternate product.

C. Pay for laboratory testing, as well as any other review or examination costs, needed to establish the equivalency between products in order to obtain information upon which the Owner's Representative can base a decision.

D. If the Owner's Representative determines that an alternate product is not equal to that named in the Specifications, the Contractor shall furnish one of the specified products.

1.05 OWNER'S REVIEW

A. Alternate products or processes may be used only if approved in writing by the Owner's Representative. The Owner's Representative's determination regarding acceptance of a proposed alternate product is final.

B. Alternate products will be accepted if the product is judged by the Owner's Representative to be equivalent to the specified product or to offer substantial benefit to the Owner.

C. The Owner retains the right to accept any product or process deemed advantageous to the Owner, and similarly, to reject any product or process deemed not beneficial to the Owner.

1.06 SUBSTITUTION PROCEDURE

A. Collect and assemble technical information applicable to the proposed product to aid in determining equivalency as related to the approved product specified.

B. Submit a written request for a construction product to be considered as an alternate product.

C. Submit the product information after the effective date of the Agreement and within two weeks of that date. After the submittal period has expired, requests for alternate products will be considered only when a specified product becomes unavailable because of conditions beyond the Contractor's control.

D. Submit 5 copies of each request for alternate product approval. Include the following information:

1. Complete data substantiating compliance of proposed substitution with Contract Documents

2. For products:

    a. Product identification, including manufacturer's name and address

    b. Manufacturer's literature with product description, performance and test data, and reference standards

    c. Samples, as applicable

    d. Name and address of similar projects on which product was used and date of installation. Include the name of the Owner, Owner's Representative, and installing contractor.

3. For construction methods:

    a. Detailed description of proposed method

    b. Drawings illustrating methods

4. Itemized comparison of proposed substitution with product or method specified

5. Data relating to changes in construction schedule

6. Relation to separate contracts, if any

7. Accurate cost data on proposed substitution in comparison with product or method specified.

8. Other information requested by the Owner's Representative.

E. Approved alternate products will be subject to the same review process as the specified product would have been for shop drawings, product data, and samples.

F. The Owner desires to have the products and processes as specified in the contract. The consideration and approval of the alternative product or process is at the sole discretion of the owner.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01655

STARTING SYSTEMS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Starting systems.

B. Demonstration and instructions.

C. Testing, adjusting and balancing.

1.02 MEASUREMENT AND PAYMENT

A. Unless indicated as a bid item, no separate payment will be made for work performed under this Section. Include cost in Bid Items for which this work is a component.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Coordinate Schedule for start-up of various equipment and systems.

B. Notify the Owner Representative seven (7) days prior to startup of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other damage-causing conditions.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision in accordance with manufacturer's instructions.

G. When specified in individual Technical Specification sections, require manufacturer to provide an authorized representative to be present at the site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit written report indicating that equipment or system has been properly installed and is functioning correctly.

3.02 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to the Owner Representative two (2) weeks prior to date of substantial completion.

B. Utilize O&M manuals as the basis for instruction. Review contents of manual with the Owner Representative in detail to explain aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at the equipment location.

D. Prepare and insert additional data in O&M manuals when the need for additional data becomes apparent during instruction.

E. At a minimum, the Contractor will demonstrate the following:

1. Products and procedures to be used in maintaining various surfaces, e.g., counter tops, toilet partitions, tile floors and carpeting;

2. Procedures to set and maintain landscape irrigation system;

3. Procedures to set and maintain security and fire alarm systems; and

4. Procedures to set and maintain HVAC systems.

3.03 TESTING, ADJUSTING AND BALANCING

A. Contractor shall start, test, adjust, balance, and provide reports on all installed equipment as provided for in this section.

B. Owner may also appoint, employ, and pay for services of an independent firm to perform testing, adjusting, and balancing.

C. Reports will be submitted by both the Contractor and the independent firm (if utilized) to the Owner indicating observations and results of the tests and indicating compliance or non-compliance with specified requirements and with the requirements of the Contract Documents.

D. Owner’s employment of an independent firm shall not relieve the Contractor’s responsibility under this section.

END OF SECTION

SECTION 01661

INSTRUCTION OF OPERATION AND MAINTENANCE PERSONNEL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

This section includes the requirements for the Contractor's instruction of the Owner's operation and maintenance personnel.

1.02 REQUIREMENTS

A. Equipment manufacturer shall provide the services of a factory-trained maintenance specialist to instruct the Owner's operations and maintenance personnel in the recommended corrective and preventive maintenance procedures for all equipment, as specified in the respective equipment section(s) of these specifications.

B. Contractor shall be responsible for coordinating these services at times acceptable to the Owner, with a minimum of 30 days prior notice.

C. Manufacturer shall provide a combination of classroom and field training, as required to sufficiently comply with all training requirements. In general, manufacturer's instruction of operation and maintenance personnel shall be limited to one 8-hour day, unless otherwise necessitated to sufficiently complete required procedures outlined herein.

1.03 SUBMITTALS

A. Submit Contractor's proposed operation and maintenance personnel training schedule.

B. Submit manufacturer's training materials, including specific instruction topics, planned "hands-on" demonstrations, training aids to be utilized.

C. Submit credentials of designated manufacturer's representative. Credentials will include a brief resume and specific details of the instructor's experience with maintenance of and training on the equipment specified.

D. Submit attendance logs (sign in sheets) documenting employees who received instruction subsequent to all completed training sessions.

1.04 INSTRUCTION PLAN

A. Manufacturer's representative instruction session shall include, but not be limited to, the following:

1. Equipment Operation.
   a. Describe equipment's operating (process) function.
   b. Describe equipment's fundamental operating principals and dynamics.
   c. Identify equipment's mechanical, electrical and electronic components and features.
   d. Identify all support equipment associated with the operation of subject equipment (i.e., air intake filters, valve actuators, motors).
   e. Operating instructions for start up, normal operation, regulation and control, normal shutdown, and emergency shutdown.

2. Detailed Component Descriptions.
   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 to:
      1) Perform an inspection of the equipment in operation.
      2) Spot potential trouble symptoms (anticipate breakdowns).
      3) Forecast maintenance requirements (predictive maintenance).
   b. Define the recommended PM intervals for each component.
   c. Provide lubricant and replacement part recommendations and limitations, along with recommended spare parts.
   d. Describe appropriate cleaning practices and recommended intervals.
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.
5. Equipment Corrective Maintenance.
   a. Describe recommended equipment preparation requirements.
   b. Identify and describe the use of any special tools required for maintenance of the equipment.
   c. Describe component removal/installation and disassembly/assembly procedures.
   d. Perform demonstrations of common corrective maintenance repairs.
   e. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
   f. Define recommended torquing, mounting, calibration and/or alignment procedures and settings, as appropriate.
   g. Describe recommended procedures to check/test equipment following a corrective repair.

B. The manufacturer's representative shall incorporate training aids as appropriate to assist in the instruction. At a minimum, the training aids shall include text and figure handouts. Other appropriate training aids are:

1. Audiovisual aids such as films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, and catalogue sheets.
2. Equipment cutaways and samples such as spare parts, damaged equipment, etc.
3. Tools such as repair tools, customized tools, measuring and calibrating instruments.

C. The manufacturer's representative shall utilize descriptive handouts during the instruction. Photocopied handouts shall be good quality reproductions. Handouts should accompany the instruction with frequent reference made to them. Customized handouts developed especially for the instruction are encouraged. Minimum of ten copies of all training materials shall be provided.

D. The manufacturer's representative shall present at least one "hands-on" demonstration of common corrective maintenance repairs. The manufacturer's representative shall provide the tools and equipment necessary to conduct the demonstration(s).

E. In any "hands-on" training situation where Owner's operation or maintenance personnel participate in disassembly or assembly of equipment components, the manufacturer shall be responsible for such disassembly or assembly and for proper equipment operation subsequent to such activities.

PART 2 P R O D U C T S – NOT USED

PART 3 E X E C U T I O N – NOT USED

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Closeout procedures including final submittals such as operation and maintenance data, warranties, and spare parts and maintenance materials.

1.02 CLOSEOUT PROCEDURES

A. Comply with the General Conditions of Agreement regarding Final Completion and Final Payment when Work is complete and ready for Owner Representative's final inspection.

B. Provide Project Record Documents prior to request for final closeout.

C. Complete or correct items on punch list, with no new items added to said punch list.

D. Any new items not on the original punch list that are discovered or arise after the punch list is a warranty item and will be addressed within no more than 30 days of notification by the City (or sooner if required by specific circumstances) during warranty period.

E. The Owner will occupy portions of the Work as specified in other Sections.

F. Provide submittals as required by governing authorities.

G. Any punch list items will be completed to the Owner’s satisfaction prior to final payment.

1.03 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Clean debris from drainage systems.

C. Clean site; sweep paved areas, rake clean landscaped surfaces.

D. Remove waste and surplus materials, rubbish, and temporary construction facilities from the site following the final test of utilities and completion of the work.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operations and maintenance data in accordance with the sections and provisions of the specifications.

1.05 WARRANTIES

A. Provide one original of each warranty from Subcontractors, suppliers, and manufacturers.

B. Provide Table of Contents and assemble warranties in 3-ring/D binder with durable plastic cover.

C. Submit warranties prior to final Application for Payment.

D. Warranties shall commence in accordance with the requirements in the Special Conditions.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01710

CLEANING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Execution of cleaning during progress of daily work, and at completion of work.

B. Maintaining premises and public properties (including storage yards) free from accumulations of waste, debris and rubbish caused by operations.

C. At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials:

1. Clean all surfaces exposed to sight.

2. Leave project clean and ready for occupancy or use.

1.02 UNIT PRICES

A. No separate payment will be made for cleaning under this section. Include payment in unit price for related work.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Use cleaning materials recommended by manufacturer of surface to be cleaned.

B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

C. See each specification section for specific products if applicable.

PART 3 E X E C U T I O N

3.01 DURING CONSTRUCTION

A. Execute cleaning to ensure that building, grounds and public properties are maintained free from accumulations of waste materials and rubbish.

B. Wet down dry materials and rubbish to settle dust and prevent blowing dust.

C. At daily intervals during progress of work, clean site and public properties.

D. Legally and properly dispose of waste materials, debris, and rubbish.

E. Provide on-site containers for collection of waste materials, debris and rubbish.

F. Provide wire fence or equivalent around debris piles to prevent blowing of debris from project site.

G. Remove waste material, debris, and rubbish from site.

H. Legally dispose of debris at public or private dumping areas off Owner's property.

I. Handle materials in a controlled manner with as few handlings as possible.

J. Owner may dictate cleaning equipment and methodology.

3.02 SAFETY REQUIREMENTS

A. Hazards Control:

1. Store volatile wastes in covered metal containers.

2. Remove containers from premises daily.

3. Prevent accumulation of wastes which create hazardous conditions.

4. Provide adequate ventilation during use of volatile or noxious substances.

B. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws:

1. Do not burn or bury rubbish and waste materials on project site.

2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

3. Do not dispose of wastes into stream or waterways.

4. Cleanup after haul trucks.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Maintenance and Submittal of Record Documents and Samples.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Maintain one record copy of documents at the site in accordance with the General Conditions.

B. Store Record Documents and samples in field office if a field office is required by Contract Documents, or in a secure location. Provide files, racks, and secure storage for Record Documents and samples.

C. Label each document "PROJECT RECORD" in neat, large, printed letters.

D. Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.

E. Keep Record Documents and Samples available for inspection by Owner's Representative.

1.03 RECORDING

A. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.

B. Contract Drawings and Shop Drawings: Legibly mark each item to record all actual construction, or "as built" conditions, including:

1. Measured horizontal locations and elevations of underground utilities and appurtenances, referenced to permanent surface improvements.

2. Elevations of underground utilities referenced to bench mark utilized for project.

3. Field changes of dimension and detail.

4. Changes made by modifications.

5. Details not on original contract drawings.

6. References to related shop drawings and Modifications.

C. Record information with a red pen on a set of full size original construction drawings.

1.04 SUBMITTALS

A. At contract closeout, deliver Project Record Documents to Owner's Representative.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Submittal requirements for manufacturers' operation and maintenance (O&M) data.

B. Submittal requirements for O&M data notebooks.

1.02 UNIT PRICES

A. The value and payment of approved equipment operation and maintenance manuals is incidental to the amount bid for equipment and installation. Project retainage will not be released until O&M manuals have been delivered and accepted by Owner.

1.03 REQUIREMENTS

A. Furnish manufacturers' operation and maintenance data notebooks for equipment and components as required by the individual technical specifications in accordance with all sections and provisions of these specifications.

B. Furnish O&M data notebooks in accordance with the requirements of this Section.

1.04 SUBMITTALS

A. Submit O&M data for manufacturers' equipment and components, as required.

B. For projects which include multiple facilities, provide separate O&M data submittals noted accordingly.

C. Manufacturers' O&M data submittals shall have been reviewed and accepted by the Owner's Representative prior to requesting operational testing.

D. Submit three (3) copies of complete O&M data notebooks and electronic copies on disks meeting the requirements of this Section to the Owner's Representative 14 days prior to the scheduled demonstration testing and facility start-up.

E. Compile the O&M data notebook of all approved manufacturer O&M data submittals previously reviewed and accepted by the Owner's Representative and organize in accordance with the requirements of this Section.

F. Incorporate revisions or additional data required for the O&M data notebook, due to system start-up and demonstration testing, and resubmit as a condition of final payment.

1.05 O&M DATA

A. For each product or system: list names, addresses, e-mail addresses and telephone numbers of suppliers and service representatives, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

D. Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

E. Warranties, Guarantees and Bonds: Bind in a copy of each.

1.06 O&M REQUIREMENTS

A. For each item of equipment and each system include a description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include function, normal operating characteristics, and limiting conditions. Include performance curves where applicable, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

B. Data submitted on equipment shall include complete maintenance instructions (including preventive and corrective maintenance) and parts lists in sufficient detail to facilitate ordering replacements.

C. Operating Procedures: Include start-up, and normal operating instructions and sequence. Include regulation, control, stopping, shut-down, and emergency instructions.

D. Provide servicing and lubrication schedule, and list of lubricants required. Cross-reference lubricants to products offered by at least three major lubricant suppliers. Note lubrication points on Drawings.

E. Include manufacturer's printed operation and maintenance instructions.

F. Include sequence of operation by controls manufacturer.

G. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams, and diagrams required for maintenance.

H. Troubleshooting guides.

I. Complete spare parts list with predicted life of parts subject to wear, list of spare parts recommended on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

1.07 O&M DATA NOTEBOOKS

A. The Contractor shall compile O&M data notebooks for each facility consisting of the assembled manufacturer's O&M data submittals which were previously reviewed and accepted by the. Owner's Representative The O&M data notebooks are required before demonstration testing or start-up activities.

B. Submit O&M data notebooks, bound in 8½ x 11 inch text pages, 3-ring/D binder notebooks with durable plastic covers as well as electronic media containing the O&M manuals in acceptable electronic format.

C. Provide binder covers and spines with computer printed title "OPERATION AND MAINTENANCE DATA", title of project, facility name and address.

D. For projects with multiple facilities, provide separate O&M data notebooks specific to each facility.

E. Provide separate binder notebooks based on category of equipment or components submitted. Note as either "Mechanical", "Electrical", or "Instrumentation" on the cover and spine. DO NOT combine these into one binder.

F. All binder notebooks shall be provided with labeled, tabbed, dividers logically arranged, and shall include a Table of Contents noting all sections, drawings, diagrams, vendor data, and other documents.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 02050

DEMOLITION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Demolishing and removing existing structures, equipment and materials only to the extent as required in the execution work detailed in the contract documents.

B. Disposing of demolished materials and equipment.

1.02 UNIT PRICES

A. Measurement for demolition is on a lump sum basis for each contiguous area, including submittal of proposed demolition and removal schedule.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all provisions and sections within these specifications.

B. Submit proposed methods, equipment, materials and sequence of operations for demolition of structures. Describe coordination for shutting off, capping, and removing

utilities. Plan operations to minimize temporary disruption of utilities to existing facilities or adjacent property.

C. Submit proposed demolition and removal schedule for approval. Notify Owner's Representative in writing at least 72 hours before starting demolition.

D. Submit an approved copy of demolition schedule to Fire Department prior to commencement of demolition operations.

E. Obtain a permit for building demolition, as required.

1.04 OWNERSHIP OF MATERIAL AND EQUIPMENT

A. Materials and equipment designated for reuse or salvage are listed in Section 01010 - Summary of Work. Protect items designated for reuse or salvage from damage during demolition, handling and storage. Restore damaged items to satisfactory condition.

B. Materials and equipment not designated for reuse or salvage become the property of the Contractor.

1.05 STORAGE AND HANDLING

A. Store and protect materials and equipment designated for reuse until time of installation.

B. Deliver and unload items to be salvaged to storage areas indicated on Drawings.

C. Remove equipment and materials not designated for reuse or salvage and all waste and debris resulting from demolition from site. Remove material as work progresses to avoid clutter.

1.06 ENVIRONMENTAL CONTROLS

A. Minimize spread of dust and flying particles. If required by governing regulations, use temporary enclosures and other suitable methods to prevent the spread of dust, dirt and debris.

B. Use appropriate controls to limit noise from demolition to levels designated in local ordinances.

C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.

D. Stop demolition and notify Owner's Representative if underground fuel storage tanks, asbestos, PCB's, contaminated soils, or other hazardous materials are encountered.

E. Dispose of removed equipment, materials, waste and debris in a manner conforming to applicable laws and regulations.

PART 2 P R O D U C T S

2.01 EQUIPMENT AND MATERIALS FOR DEMOLITION

A. Use equipment and materials approved under Paragraph 1.03, Submittals.

B. Fires are not permitted.

C. Do not use a "drop hammer" where the potential exists for damage to underground utilities, structures, or adjacent improvements.

PART 3 E X E C U T I O N

3.01 EXAMINATION AND PRE-CONSTRUCTION SUBSURFACE UTILITY INVESTIGATION BY CONTRACTOR TO AVOID CONFLICTS-**NO SEPARATE PAY**

A. Contractor is responsible for Determining Conflicts with Structures, Regulatory Features (Wetlands, protected ecology, and utilities both public and private prior to construction—No Separate Pay.

B. Contractor is responsible for Determining Conflicts with Structures, Regulatory Features (Wetlands, protected ecology, and utilities both public and private prior to construction—No Separate Pay.

C. Owner’s Representative will mark or list existing equipment to remain the property of the Owner.

D. Do not proceed with demolition or removal operations until after the joint inspection and subsequent authorization by Owner’s Representative.

E. The accurate location of all utilities, structures, landscaping, irrigation, etc., as shown is approximate and all may not be shown on the plans, quantified on the bid forms, or detailed in the specifications. Contractor is responsible for confirming the material, size, location and other details of all objects including pipelines, structures, conduits and cables and surface, subsurface and environmental conditions (ex: water depth), etc. The City of Galveston requires the Contractor to pre-locate, pre-verify and pre-investigate all utilities (shown or not shown) before construction of this project by whatever method subject to approval by the owner which includes but is not limited to the following:

i. Utilization of metal detection equipment and probes
ii. Excavation, ex: hydrovac pot holing
iii. Opening manholes to determine the flow line of storm pipes and sanitary sewer
iv. Measuring the depth to valve nut and adding 18” to determine the depth to waterlines
v. Probing to identify sprinklers and services

vi. Subsurface Utility Investigation (SUE) Level A through D survey which includes i thru' v.

F. All investigative work shall be done and all repairs required after investigation shall be accomplished by the contractor (no separate pay).

G. Contractor agrees to be fully responsible for any and all damages, increase in cost, or delays in schedule for change in their construction scope including any and all damages which might be caused by their failure to exactly locate and preserve all utilities.

H. Contractor shall be responsible for contacting all utility companies through an "811 Call Before You Dig" at least 14 calendar days prior to construction in area of known and unknown utilities which may not be shown on the plans.

I. If the contractor requests the City Staff to assist with locating utilities, structures or other surface and below ground features, the City will invoice the contactor for such services, and this cost will be deducted from the contractor's pay estimates.

J. Above ground utility information may be obtained by standard land surveying methods. Underground utility locations may be determined by conventional survey methods, newer technologies, or by Subsurface Utility Evaluation (SUE). The SUE process combines surveying and geophysics to accurately identify, characterize, and map underground utilities. To avoid construction issues and delays that create cost overruns, the contractor should AVOID, MITIGATE, or ADJUST for project utility conflicts. Early design and planning phases should include subsurface site characterization of various geologic, environmental, and utility features.

Responsible Party. Contractor (No Separate Pay)

K. Locate existing utilities. This task involves physically locating, marking, and surveying the physical features of utilities. If utility maps are not available, knowledge and survey of the aboveground structure types can indicate the complexity.

This task identifies utilities specifically and determines elevations as well as horizontal positions. Examples might include manhole covers, gas pipes, overhead lines, and fiber-optic cables. There are standard location methods and newer technologies used for underground utility locating survey, such as subsurface utility evaluation (SUE), metal detection (MD), ground-penetrating radar (GPR), and electromagnetic line location (EMLL). Topographic surveys may be adequate for project locations with few underground utilities (i.e., in rural areas).

Undocumented utilities may have been installed without a record of their location. EMLL or GPR should be used to mark locations on the ground followed by invasive potholing or excavation to determine the utility type. GPR can detect

non-metallic targets without tracer wire. SUE is a non-destructive utility investigation to accurately locate, identify, and map underground utilities.

Responsible Party. Contractor (No Separate Pay)

Subtasks.

- Locate, log, and survey visible features of utilities.
- To confirm and survey locations of strategic subsurface features, it may be necessary to "pothole" or excavate down to the utility after using MD, GPR, or EMLL.
- Mark and label locations of subsurface utilities on the ground with stakes, laths, or other means.
- Survey utility locations.
- Manhole covers and other obstructions may need to be adjusted for resurfacing projects.

Critical Sequencing.

- To avoid costly conflicts utility location data needs to be collected before beginning construction.
- Utility data is needed before establishing final alignments of the roadway and related features (e.g., storm drains, utilities, and other excavation work) to avoid these conflicts and eliminate construction delays or service outage..

Authority.

- Utilities Code Chapter 251 - Underground Facility Damage Prevention and Safety

L. Subsurface Utility Evaluation (SUE). Contractors should be competent and knowledgeable, experienced, insured, timely, and have the equipment and financial capacity to provide the service prior to construction and at no cost to the City (No Separate Pay). Major activities involved in SUE are:

- **Designating:** Surface geophysical techniques to determine the existence and horizontal position of subsurface utilities. Above ground surface markers (stakes, flags, etc.) or on the ground surface marking (paint) mark the location.

- **Locating**: Process of exposing precise horizontal and vertical position, size, and configuration of subsurface utilities.
- **Data Management**: Process of locating, surveying, and designating information and transferring it into project GIS files, plans, or CAD system.
- **Conflict Analysis**: Using a conflict matrix to do an evaluation and compare designating information with proposed plans to inform all stakeholders of potential conflicts, possible resolutions, and costs to resolve.
- **Quality Level D (QL-D).** The most basic level of information. It comes from existing utility records or oral recollections. Its usefulness should be confined to project planning and route selection activities.
- **Quality Level C (QL-C).** It involves surveying visible aboveground utility facilities, such as manholes, valve boxes, posts, etc., and correlating this information to Quality Level D. Its usefulness should be confined to rural projects where utilities are not prevalent, or are not too expensive to repair or relocate.
- **Quality Level B (QL-B).** Using appropriate surface geophysical methods to determine the existence and approximate horizontal position of subsurface utilities. This two-dimensional horizontal mapping information is usually sufficient to accomplish preliminary utility conflict elimination preliminary goals which needs to be further confirmed. Decisions can be made on where to place storm drainage systems and other design features in order to avoid conflicts with existing utilities. Slight adjustments in the design can produce substantial cost savings by eliminating utility relocations.
- **Quality Level A (QL-A).** Precise vertical and horizontal location of subsurface utilities obtained by exposure and subsequent measurement, usually at a specific point. Information provides the highest level of accuracy presently available. When surveyed and mapped, precise plan and profile information is available for use in making final design decisions. The use of nondestructive digging equipment, particularly vacuum excavation, eliminates damage to underground utility facilities traditionally caused by backhoes.

3.02 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the work.

C. Perform demolition in a manner to prevent damage to adjacent property. Repair damage to City property, public right of way or adjacent property and facilities at no cost to the owner.

D. The Contractor shall be responsible for safety and integrity of adjacent structures and shall be liable for any damage due to movement or settlement. Provide proper framing and shoring necessary for support. Cease operations if an adjacent structure appears to be endangered. Resume demolition only after proper protective measures have been taken.

E. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

F. To minimize the inconvenience to the public and to maintain better quality control, the total of all demolition, construction and testing activities cannot exceed 2-lanes in one direction (includes parking lane) for a total length of one-thousand (1,000) linear feet or three City Blocks in length, whichever is less. This aforementioned length, shall be completed in its entirety and all services restored including access to driveways, sidewalks and ADA ramps, roads, etc., prior to work commending on the next section.

3.03 UTILITY SERVICES

A. Follow rules and regulations of authorities or companies having jurisdiction over communications, pipelines, and electrical distribution services.

B. Notify and coordinate with utility company and adjacent building occupants when temporary interruption of utility service is necessary.

3.04 DISPOSAL

A. Remove from the site all items contained in or upon the structure not designated for reuse or salvage. Conform to requirements of Section 01500 - Temporary Facilities and Controls or Section 01564 - Waste Material Disposal.

B. Follow method of disposal as required by regulatory agencies.

3.05 MECHANICAL WORK ITEMS

A. Mechanical removals consist of dismantling and removing existing piping, pumps, motors, water tanks, equipment and other appurtenances. It includes cutting, capping, and plugging required to restore use of existing utilities.

B. Remove existing process, water, chemical, gas, fuel oil and other piping not required for new work. Take out piping to the limits shown or to a point where it will not interfere with the new work. Piping not indicated to be removed or which does not interfere with new work shall be removed to the nearest solid support, capped, and the remainder left in place. Purge chemical and fuel lines and tanks. Verify that such lines are safe prior to removal or capping.

C. Where piping that is to be removed passes through existing walls, cut and cap piping on each side of the wall. Use cap appropriate for pipe material to be capped. Provide fire-rated sealant for walls classified as fire-rated.

D. When underground piping, which is not located in the public right-of-way, is to be altered or removed, cap the remaining piping. Abandoned underground piping may be left in place unless it interferes with new work or is shown or specified to be removed. For piping to be abandoned, fill with sand, pressure grout or other approved method and plug with concrete or brick masonry bulkhead unless otherwise approved by the Owner.

E. Remove waste and vent piping to points shown. Plug pipe and cleanouts and plugs. Where vent stacks pass through an existing roof that is to remain, remove the stack and

patch the hole in the roof, making it watertight. Comply with requirements of existing roof installer so as to maintain roof warranty.

F. Conform to applicable codes when making any changes to plumbing and heating systems.

3.06 ELECTRICAL WORK ITEMS

A. Electrical removals consist of disconnecting and removing existing switchgear, distribution switchboards, control panels, bus duct, conduits and wires, panelboards, lighting fixtures, and miscellaneous electrical equipment.

B. Remove existing electrical equipment and fixtures to prevent damage to allow continued operation of existing systems and to maintain the integrity of the grounding systems.

C. Remove poles and metering equipment, if designated for removal on the Drawings. Coordinate electrical removals with the power company, as necessary. Verify that power is properly de-energized and disconnected.

D. Where shown or otherwise required, remove wiring in underground duct systems. Verify function of wiring before disconnecting and removing. Plug ducts which are not to be reused at entry to buildings.

E. Changes to electrical systems shall conform to applicable codes.

END OF SECTION

SECTION 02051

ABANDONMENT OF SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Abandonment in place of existing sanitary sewers, manholes, and force mains.

1.02 UNIT PRICES

A. Measurement for grout fill and abandonment of existing gravity sewers is on a linear foot basis for each diameter of sewer being abandoned. Measurement will be along the centerline of the sewer from centerline to centerline of manholes.

B. Measurement for grout fill and abandonment of sanitary sewer manholes is by each manhole abandoned in conformance with this Section.

C. Payment will be full compensation for all material, equipment, and labor required for complete abandonment grouting, including air venting, testing, temporary plugs, pipes and all incidentals.

D. No separate payment will be made for plugging and abandoning sanitary sewer force mains. Include the cost of such abandonment in related work.

E. Acceptability of grout material is based on achieving an average strength of at least 75 as defined in Paragraph 2.01B.1.

1.03 DEFINITIONS

A. Abandonment. Sanitary sewer abandonment consists of demolition and removal of any portion of manholes existing within the specified depth of the surface, and the abandonment in place of sewer lines and manholes as specified in this Section.

B. Flowable Fill. Flowable fill (abandonment grout) shall be a controlled low-strength material consisting of a fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in sewer pipes or other restricted areas, or as mass placement by chutes or tremie methods in unrestricted locations with open access. The long-term hardened strength shall be within a specified range.

C. Ballast. Large aggregate either replaced with the voids subsequently filled with flowable fill injected by grouting method; or in areas with open access, placed individually and sequentially at the same time as the flowable fill placement.

D. Backgrouting. A secondary stage pressure grouting to ensure that voids have been filled within the abandoned sewer. Back grouting will only be required at critical locations indicated on the Drawings or if there is evidence of incomplete flowable fill placements.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Flowable fill mix design report:

1. Flowable fill type and production method.

2. Use of ballast. Provide percentage of ballast of the total placement and size limits for the ballast if fill is intended to be used with ballast.

3. Aggregate gradation of fill. The aggregate gradation of the mix (excluding ballast) shall be used as a pilot curve for quality control during production.

4. Fill mix constituents and proportions including materials by weight and volume, and air content but excluding ballast. Give types and amounts of admixtures including air entrainment or air generating compounds.

5. Fill densities and viscosities, including wet density at the point of placement.

6. Initial time of set.

7. Bleeding and shrinkage.

8. Compressive strength.

C. Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.

D. Experience record for the proposed crew, showing a minimum of 5 similar projects using the proposed or similar equipment and methods.

E. At least 60 days prior to commencing any abandonment activities, submit a plan for abandonment, describing the proposed grouting sequence, bypass pumping requirements and plugging, if any, and other information pertinent to completion of the work.

PART 2 P R O D U C T S

2.01 FLOWABLE FILL

A. Design Mix Criteria. Provide design of one or more mixes to meet the design criteria and conditions for placement. Present the information required by Paragraph 1.05B in the mix design report including the following:

1. Cement: ASTM C150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 100 pounds per cubic yard.

2. Fly ash: ASTM C618 Class C or F. Volume and weight per cubic yard of fill. Provide minimum Fly ash content of 200 pounds per cubic yard.

3. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.

4. Aggregate gradation: 100 percent passing the 3/8 inch sieve and not more than 10 percent passing the #200 sieve. The mix design report shall define a pilot gradation based on the following sieve sizes 3/8-inch, Nos. 4, 8, 16, 30, 50, 100 and 200. Do not deviate from the pilot gradation by more than +/-10 percentage points for any sieve for the production material.

5. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, at least 30 percent of natural aggregate shall be added as necessary to provide workability.

6. Admixtures: Use admixtures meeting ASTM C494 and ASTM C107 as needed to improve pumpability, to control time of set, and reduce bleeding.

7. Fluidifier: Use a fluidifier meeting ASTM C397 as necessary to hold the solid constituents in suspension. Add a shrinkage compensator if necessary.

8. Performance additive: Use a flowable fill performance additive, such as Darafill or approved equal, to control the fill properties.

B. Flowable Fill Requirements

1. Unconfined compressive strength: minimum 75 psi at 56 days as determined based on an average of three tests for the same placement. Present at least three acceptable strength tests for the proposed mix design in the mix design report.

2. Placement characteristics: self-leveling.

3. Shrinkage characteristics: non-shrink.

4. Water bleeding for fill to be placed by grouting method in sewers: not to exceed 2 percent according to ASTM C940.

5. Minimum wet density: 90 pounds per cubic foot.

2.02 BALLAST

A. Ballast material: natural rock or concrete pieces with a minimum size equal to at least 10 times the maximum aggregate size of the flowable fill and a maximum size of 24 inches. The maximum dimension shall not be more than 20 percent of the minimum dimension of the space to be filled.

B. Ballast composition: free of any regulated waste material.

2.03 PLUGS FOR FORCE MAINS

A. Grout Plugs: Cement-based dry-pack grout conforming to ASTM C1107, Grade B or C.

B. Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with the pipe being abandoned.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Have fill mix design reports and other submittals required by Paragraph 1.05 accepted by the Owner's Representative prior to start of placement. Notify the Owner's Representative at least 24 hours in advance of grouting with flowable fill.

B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at a pressure that will not distort or imperil any portion of the work, new or existing.

C. Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess the condition of the pipe. Locate previously unidentified connections, which have not been redirected and reconnected as a part of this project, and report them to the Owner's Representative. During placement of the fill, compensate for any irregularities in the sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

D. Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and any other substances that may degrade performance of the fill. Do not leave sludge or other debris in place if filling more than 2 percent of the placement volume. Dispose of waste material in compliance with Section 01500 - Temporary Facilities and Controls.

E. Remove free water prior to starting fill placement.

3.02 EQUIPMENT

A. Mix flowable fill in an automated batch plant and deliver it to the site in ready-mix trucks. Performance additives may be added at the placement site if required by mix design.

B. Use concrete or grout pumps capable of continuous delivery at the planned placement rate.

3.03 DEMOLITION OF ABANDONED SANITARY SEWER MANHOLES, PIPELINE STRUCTURES AND FORCE MAINS PRIOR TO ABANDONMENT

A. Remove manhole frames and covers and any castings from other existing pipeline structures. Deliver these castings to the Owner's storage yard. Alternatively, salvaged castings may be used upon approval by the Owner's Representative for construction of new manholes on this project.

B. Demolish and remove precast concrete adjustment rings and corner section, or brick and mortar corbel and chimney, or other pipeline structure, to a minimum depth of 4 feet below finished grade. The structure may be removed to a greater depth, but not deeper than 18 inches above the crown of the abandoned sewer.

C. If the adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to the manhole in preparation for filling the manhole.

D. Excavate overburden from force mains to be abandoned at the locations indicated on the Drawings. Cut the existing force main, if necessary, to provide an end surface perpendicular to the axis of the pipe and suitable for the plug to be installed. Remove any force main piping material remaining outside of the segment to be abandoned.

3.04 INSTALLATION

A. Abandon sewer lines by completely filling the sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, together with ballast as applicable, within the depth of structures left in place.

B. Place flowable fill to fill the volume between the manholes as completely as practicable. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.

C. Have the filling operation performed by experienced crews with equipment to monitor density of the flowable fill and to control pressure.

D. Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep the lines free of flowable fill.

E. Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain the flowable fill in the

lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.

F. Place flowable fill under pressure flow conditions into a properly vented open system until flowable fill emerges from the vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill the sewer from the downstream end, to discharge at the upstream end.

G. Inject flowable fill through replaced ballast using grouting equipment and a series of grout pipes discharging at the bottom of the placement, allowing the fill to rise through the ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at the same time as flowable fill is placed. Do not fill with ballast more than 50 percent of the volume at any level to prevent nesting and void formation.

H. Remediate placement of flowable fill which does not fill voids in a sewer, in manhole or other structures, or where voids develop due to excessive shrinkage or bleeding of the fill by using pressure grouting either from inside the sewer or from the surface.

I. Plug each end of force mains being abandoned.

J. Force main abandonment

1. Clean the inside surface of force mains at least 12 inches from the ends, as necessary, to achieve a firm bond and seal the grout plug or manufactured plug to the pipe surface. Similarly, clean and prepare the exterior pipe surface if a manufactured cap is to be used.

2. When using a grout plug, place a temporary plug or bulkhead approximately 12 inches inside the pipe. Fill the pipe end completely with dry-pack grout mixture.

3. When using a manufactured plug or cap, install the fitting, as recommended by the manufacturer's instructions, to form a watertight seal.

K. Backfill to the surface, above the pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with these specifications.

L. Collect and dispose of excess flowable fill material and other debris in accordance with all sections of these specifications.

3.05 FIELD QUALITY CONTROL

A. Provide batch plant tickets for each truck delivery of flowable fill. Note on the tickets addition of admixtures at the site.

B. Check flow characteristics and workability of the fill as the placement proceeds.

C. Obtain at least three test cylinders for each placement area for determination of 56 day compressive strength and bleeding. The acceptance of the placement will be based on the average strength of the three tests.

D. Record the volume of ballast together with the flowable fill placement for the same space to demonstrate that voids have been filled.

3.06 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the work.

END OF SECTION

SECTION 02076

REMOVE EXISTING PAVEMENTS AND STRUCTURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Removing concrete paving, asphaltic concrete pavement, and base courses.

B. Removing concrete curbs, concrete curb and gutters, sidewalks and driveways.

C. Removing pipe culverts and sewers.

D. Removing miscellaneous structures of concrete, masonry, or combination of concrete and masonry.

1.02 UNIT PRICES

A. No separate payment will be made for removing existing pavements and structures under this Section unless included in bid documents. Include payment in unit price for work in appropriate sections.

B. Measurement, when included in bid documents, will be as follows:

1. Measurement for removing and disposing of concrete base and surfacing, and removing asphaltic surfacing, is on a square yard basis measured between lips of gutters.

2. Measurement for removing and disposing of cement stabilized shell base course, with or without asphalt surfacing, is on a square yard basis.

3. Measurement for removing and disposing of concrete base and surfacing with curbs is on a square yard basis measured from back to back of curbs. Payment includes removal of all base, asphaltic surfacing, concrete pavement, esplanade curbs, curb and gutters, and paving headers.

4. Measurement for removing and disposing of concrete pavement is on a square yard basis measured from back to back of curbs.

5. Measurement for removing and disposing of monolithic curb and gutter, removing monolithic concrete curb, and removing concrete curb is on a linear foot basis measured along the face of the curb.

6. Measurement for removing and disposing of concrete sidewalk and driveway is on a square yard basis.

7. Measurement for removing and disposing of miscellaneous concrete and masonry items is on a cubic yard basis of the structure in place.

8. Measurement for removing and disposing of pipe culverts and sewers is on a linear foot basis for each diameter of type of pipe removed.

C. No payment will be made for work outside maximum payment limits indicated on Drawings, or in areas removed for Contractor's convenience.

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.

B. Coordinate removal work with utility companies.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Obtain advance approval from Owner’s Representative for dimensions and limits of removal work.

B. Identify known utilities below grade. Stake and flag locations.

3.02 PROTECTION

A. Protect utilities that remain from damage.

B. Protect trees, other plant growth, and features designated to remain.

C. Protect adjacent public and private property from damage.

D. Protect bench marks, monuments, and existing structures designated to remain from damage or displacement.

3.03 REMOVALS

A. Remove by methods that will not damage underground utilities. Do not use a drop hammer near existing underground utilities.

B. Minimize amount of earth loaded during removal operations.

C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut a minimum depth of 2 inches.

D. Where street and driveway saw cut locations coincide or fall within three feet of existing construction or expansion joints, break-out to existing joint.

E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.

3.04 DISPOSAL

A. Inlet frames, grates, and plates; and manhole frames and covers, may remain Owner property. Disposal shall be in accordance with requirements of Section 01564 - Waste Material Disposal.

B. Remove debris resulting from Work under this section from site in accordance with requirements of Section 01564 - Waste Material Disposal.

END OF SECTION

SECTION 02105

SITE PREPARATIONS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Clearing and grubbing.

B. Removal of topsoil, stripping and stockpiling.

C. Removal of debris and trash.

D. Removal of obstructions.

E. Cutting and filling.

F. Rough grading.

G. Disposal of waste materials.

H. Disposal of excess materials.

I. Salvaging of designated items.

1.02 UNIT PRICES

A. All items within this section shall be considered incidental to the cost of the project.

1.03 PROTECTION

A. Refer to article entitled "Protection" in General Requirements.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Asphaltic Horticultural Coating:

1. Emulsified asphalt or other coating especially formulated for horticultural use on cut or injured plant tissue.

2. Waterproof, adhesive, elastic, antiseptic tree wound compound free from kerosene and coal tar creosote.

B. Liquid Fertilizer: Appropriate to the season and application.

PART 3 E X E C U T I O N

3.01 PRESERVATION OF STAKING

A. Site preparation operations shall preserve survey staking.

B. At own expense, without charge to Owner, employ surveyor to check staking, and reset any missing, disturbed, or damaged staking upon completion of site preparation.

C. Use staking to check that obstructions have been removed within designated construction areas, rights-of-way, or easements.

3.02 SITE CLEARING

A. Trees and shrubs designated to remain that sustain cutting or injury to roots, trunk, or limbs shall be pruned by a tree surgeon and cut or injury painted with asphaltic horticultural coating without cost to Owner.

3.03 DISPOSAL OF WASTE MATERIALS

A. Objectionable materials such as trash, debris, cleared and grubbed materials and unsuitable, unusable, and undesirable materials necessary and designated by Owner to be removed from construction area shall be classified as follows:

1. Combustible waste materials: Materials feasible, practical and non-toxic to dispose of by burning, including cleared and grubbed materials.

2. Incombustible waste materials: Materials not burnable, not feasible, and not practical to dispose of by burning.

B. Burning

1. Burning of combustible waste materials and cleared and grubbed materials will not be permitted.

C. Waste materials shall become property of Contractor and shall be legally disposed of by contractor outside the limits of Owner's controlled property.

3.04 EXCESS MATERIAL

A. Excess material designated by the Owner to be removed shall become the property of the contractor and he shall remove excess material from Owner's controlled property and legally dispose of it. Excess material excavated cannot leave Galveston Island.

3.05 ROUGH GRADING

A. The site shall be rough-graded to eliminate holes and sharp breaks in grade and to fit into area drainage pattern.

B. The site shall drain readily.

3.06 CONSTRUCTION LIMITS

A. To minimize the inconvenience to the public and to maintain better quality control, the total of all demolition, construction and testing activities cannot exceed 2-lanes in one direction (includes parking lane) for a total length of one-thousand (1,000) linear feet or three City Blocks in length, whichever is less.

END OF SECTION

SECTION 02222

BORROW

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Soil materials for embankment.

B. Not to include beach or dune projects.

1.02 UNIT PRICES

A. Payment for borrow is on cubic yard basis calculated by compacted volume quantities using average end area method based on the Construction Drawings.

B. Borrow shall be measured at the site of embankment.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit location and description of proposed borrow area for approval. Borrow pits located on Galveston Island will require an excavation permit issued by the City.

C. Submit material samples for testing.

1.04 TESTS

A. Tests and analysis of soil materials will be performed in accordance with ASTM D4318 and ASTM D2216 under provisions of Section 01410 - Testing Laboratory Services.

PART 2 P R O D U C T S

2.01 SOIL MATERIAL

A. Excavated material shall be graded free of lumps greater than 6 inches, rocks larger than 3 inches, organic material, chemical waste or other contamination, and debris. Take borrow material from sources approved by Owner’s Representative.

B. Material to be used for topsoil shall meet or exceed requirements for soil materials of Section 02920 - Topsoil.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Notify Owner's Representative and testing laboratory 5 days in advance of opening borrow source to permit obtaining samples for qualification testing.

B. Clear approved source of trees, stumps, brush, roots, vegetation, organic matter, and other unacceptable material.

3.02 EXCAVATION

A. Provide adequate drainage of surface water so that surface water run off does not enter borrow pit excavation.

3.03 HAULING

A. Use covered trucks. Conform to requirements of Section 01570 - Traffic Control and Regulation and all local, County and State requirements.

3.04 EMBANKMENT

A. Conform to requirements of Section 02221 - Embankment.

END OF SECTION

SECTION 02223

EARTHWORK FOR SITE AREAS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section includes the requirements for the provision of clearing and grubbing, including the removal and disposal of trees, stumps, brush, roots, vegetation, logs, rubbish and other objectionable matter within project site and other designated areas, including structural excavation surface areas.

B. This section also includes the requirements for earthwork associated with the excavation of materials on site; excavation of borrow material from approved areas; compaction of natural subgrades; placement and compaction of embankments to grade; finish grading; stripping and stockpile and placement of topsoil; disposal of excess or unsuitable materials; and other required operations.

1.02 CLASSIFICATIONS

The following are brief definitions of classifications of earthwork.

A. Topsoil. Top 6 inches of natural surface soil possessing the characteristics of representative on-site soils which produce and sustain grass and other vegetative growth.

B. Stripping of Ground Surface. Stripping consists of removing all vegetation, decayed vegetable matter, rubbish and other unsuitable materials located within the areas designated for grading operations. Unless otherwise designated to remain, all areas shall be stripped to ground level prior to beginning earthwork.

C. Excavation. Consists of the required below-grade removal and proper utilization or disposal of every description and of whatever substances encountered within the grading limits of the project. Excavation shall be performed to the lines and grades indicated on the drawings.

D. 'Extra Excavation' earthwork as described in Section 3.5 below, as necessary for levee construction, shall be measured for payment by the cubic yard of 'excess material' added. Extra Excavation shall be measured in its final position and to final line and grade with the volume computed in cubic yards by the method of average end areas, relative to a pre-construction base-line survey provided by the contractor.

E. Borrow. Material taken from approved areas to make up any deficit of excavated material.

F. Waste. Excavated material which is unsuitable for reuse on site or which is in excess of the materials needed for embankment operations.

G. Subgrade. Consists of that portion of the surface on which a compacted embankment or pavement is constructed.

H. Compaction. Compaction of soil materials consists of rolling, sprinkling, tamping and otherwise working the soil to achieve a percent of Standard Proctor density as determined by ASTM D 698.

I. Embankment. Earth fill placed and compacted in successive layers to the line and grade defined by the construction plans.

J. Embankment earthwork, necessary for the construction of the levee , shall be measured in its final position and to final line and grade, with the volume of the levee embankment computed in cubic yards by the method of average end areas, relative to a pre-construction baseline survey to be provided by the contractor.

K. Finish Grading. Operations required for smoothing disturbed areas that are not overlaid with pavement or other structures. Finish grading consists of the final operations for bringing site grade to lines and grades shown on drawings.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Embankment Fill.

1. Obtain suitable fill material from site excavation operations or from borrow areas approved by the Owner's Representative.
2. Suitable fill material shall meet these specifications and be sand, gravel, earth or a combination of these materials, free from excessive silts. Fill shall be well broken up and be free of clods of hard earth, rocks and stones greater than 2-inch dimension and shall be free of trash, vegetation, organic matter and corrosive or perishable material.
3. Embankment fill must have a liquid limit of 40 maximum, ASTM D 4318.
4. Embankment fill must have a plasticity index between 10 and 20, inclusive, ASTM D 4318.
5. Not more than 40 percent of the material shall pass a No. 200 sieve, ASTM D 1140.

B. Topsoil.

1. Obtain topsoil from site or provide natural fertile, friable loam suitable for growths of grass and plants.

2. Topsoil shall contain decomposed vegetable matter, finely divided and minimum 4 percent by weight.

3. Topsoil shall be free from subsoil, clay, brush, weeds, rocks and dirt clods larger than 1 inch in diameter, stalks, roots and materials that would be toxic or harmful to growth.

2.02 EQUIPMENT

A. Contractor shall use equipment and materials as necessary to properly complete required clearing and grubbing operations.

B. Contractor shall furnish, operate and maintain equipment necessary to achieve uniform layers, sections and smoothness in grade and to meet specified compaction densities.

PART 3 E X E C U T I O N

3.01 CLEARING AND GRUBBING

A. Remove stumps, roots and other objectionable materials within construction limits to depth of 2 feet below finish grade elevation or existing grade elevation.

B. Unless otherwise specified, cleared and grubbed material shall become the property of the Contractor, and shall be removed from the site and legally disposed of. Burning of cleared and grubbed material on the Owner's property shall not be permitted.

3.02 VERIFICATION OF CONDITIONS

A. Contractor shall inform and satisfy himself as to the character, quantity and distribution of material to be excavated.

3.03 TOPSOIL REMOVAL

A. Prior to excavation or embankment activities, topsoil located within clearing limits shall be stripped to depths encountered but no less than 3 inches in depth.

B. Stripped topsoil shall be transported and deposited in stockpiles convenient to areas receiving topsoil.

C. Topsoil shall be kept separate from other excavated materials, brush, litter, weeds, stones larger than 2 inches in diameter and other materials that would interfere with planting and maintenance operations.

D. Protect stockpiled topsoil from dumping of unwanted material and dumping by the public.

E. The topsoil source and stockpile areas shall be graded to drain as far as practical during the periods of removal and storage.

3.04 EXCAVATION

A. Construction Methods.

1. Perform excavation of all types of materials encountered within limits of project to the lines, grades and elevations indicated in the plans.

2. All excavated materials shall be unclassified and no extra compensation shall be made based on types of materials encountered.

3. Materials meeting specifications for embankment fill shall be used in the formation of embankments or otherwise utilized or disposed of. Unsatisfactory and/or excess materials shall be considered waste materials and shall be disposed per the requirements of the Contract Documents.

4. If it is not possible to place material in the proper section of permanent construction at the time of excavation, stockpile the material in approved areas for later use. Stockpiled materials should be protected from dumping of unwanted materials and dumping by the public.

B. Blasting. Use of explosives for excavation operations should not be necessary and shall not be permitted.

C. Drainage. During excavation, maintain grades for complete drainage. As necessary, install temporary drains or drainage swales to intercept or divert overland flow from excavated areas. Ponding in the excavation and seepage from groundwater shall be removed per Section 02240, Dewatering and Drainage of Excavation.

D. Existing Utilities. Contractor shall field verify locations of existing utilities prior to extensive excavation operations. While it is the intent of the construction plans to show the known locations and sizes of existing utilities, the Owner's Representative retains no responsibility for lines not shown on construction plans or known to the Contractor prior to excavation. Contractor shall protect existing utilities from damage during excavation. Any damage to existing utilities shall be reported immediately and shall be satisfactorily repaired.

E. Pipelines. Contractor shall suspend machine excavation within 5 feet of any pipeline right-of-way until a pipeline company representative is present to identify pipe location and to direct further excavation operations. Notification of pipeline company and request for attendance of a representative shall be Contractor's responsibility. Contractor shall resume suspended operations only under supervision of pipeline company representative and employ only such excavation methods, means, equipment and safety measures as approved by representative. Contractor shall do no work on pipeline as part of this contract, such as lowering, cribbing up, construction of bents, repairs to coating, cutting, welding, making

repairs or other essential work, all of which shall be done by pipeline company and at their own expense. Contractor shall be solely responsible to pipeline company for any damages to their line and any related construction as a result of Contractor's operations, irrespective of any order, directive or approval by pipeline company representative, or of his presence on the work. The Contractor shall not be reimbursed directly for any extra work or expenditure as a result of intersecting any pipeline installation.

3.05 EXTRA EXCAVATION

A. Upon completion of excavation to the lines and grades given on the construction plans, areas identified as having weak or poor soil characteristics shall require extra excavation. Contractor shall remove soft or undesirable materials to a depth of 18 inches and backfill areas with stable fill material. Fill material shall comply with requirements for embankment fill and shall be compacted to specified density per the requirements of this section.

3.06 SUBGRADE UNDER PAVEMENTS

A. After excavation is made to subgrade lines under proposed pavements, proof roll and remove soft or undesirable material to a depth of 18 inches. Replace undesirable material with select embankment fill with materials and methods as specified under this section.

3.07 TREATMENT OF NATURAL SUBGRADE UNDER EMBANKMENTS/LEVEE

A. After clearing and grubbing and excavation to lines under proposed embankments, proof roll and remove soft or undesirable material to a depth of 18 inches. Break down sides of holes or depressions to flatten the slopes.

B. Fill each depression with the soil appropriate for the materials to be placed on the subgrade. Place the fill in layers moistened and compacted as specified in this section.

C. After depressions have been filled and immediately before placement of compacted fill in a section of the embankment, thoroughly scarify the foundation material to a depth of 6 inches. Remove roots and debris turned up while loosening the soil.

D. Compact the surface of the embankment subgrade as specified in this section.

E. Take care to prepare the embankment so that planes of seepage or weakness are not induced. Should the Owner’s Inspector suspect such a deficiency, the material must be thoroughly broken and recompacted before proceeding with construction.

3.08 EMBANKMENT

A. Inspection of Subgrade. Do not place fill on any part of the embankment subgrade until the subgrade preparation has been inspected by the Owner's Inspector.

B. Spreading Fill. After dumping material, break up and spread fill material. During dumping and spreading process, remove all roots, stones and debris that are uncovered in the embankment material. Construct embankments in successive horizontal layers, extending across the entire fill area. Each layer of fill shall be no greater than 8 inches in depth and shall be uniform as to material and moisture content before compaction. Individual lifts shall be scarified after compaction to prevent development of laminations between lifts. As soon as possible after placement begins, crown the surface to drain freely and maintain such conditions throughout construction.

C. Benching. When fill is to be made and compacted against hillsides and/or existing fill, the slopes of original hillside and/or fill shall be horizontally benched to key the fill material to the underlying ground. A minimum of 6 inches normal to the original slope shall be scarified and recompacted, as the fill is brought up in layers, to ensure that the new work is constructed on firm subgrade. This subsection applies to existing slopes having a steeper than 4:1 gradient.

D. Compaction. Compact each lift to required density by blading and rolling with suitable equipment. Use mechanical tamps to obtain required density in inaccessible areas. Compact to 95 percent of maximum laboratory dry density as determined by the Standard Proctor compaction test AASHTO Test Method T99 (ASTM D 698). Compaction testing shall be every 2,500 square feet per lift.

E. Moisture Control. Compaction shall be completed to the required maximum density obtainable with the natural moisture of the embankment material wherever possible. However, the moisture content shall not vary from the optimum, as determined by AASHTO Test Method T99 (ASTM D 698) by more than 3 percent or less than 1 percent. Adjust wetter than optimal materials by spreading and drying. This process may be assisted by discing or harrowing if necessary. Adjust dryer than optimal materials by sprinkling layer with water and working moisture into soil by harrowing or other approved method.

3.09 DISTRIBUTION OF TOPSOIL

A. Preparation.

1. Prior to placing topsoil, scarify the subgrade to a depth of 2 inches to provide effective bonding of the topsoil with the subgrade. Use a chisel plow with the chisels sets 10 inches apart.

2. Install topsoil to a compacted depth of at least 2 ½ inches thick when lightly compacted with rollers, using topsoil previously stockpiled and any additional topsoil required to complete this work.

3. In areas that require only blading and dressing, the adequacy of existing topsoil shall be determined by the Owner's Inspector.

B. Placement.

1. Do not haul or place wet topsoil. Do not place topsoil on subgrade that is excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading or proposed planting.

2. Distribute topsoil uniformly and spread evenly to an average thickness of 4 inches. Do not compact topsoil. Correct irregularities in the surface to prevent formation of depressions where water could stand.

3. Perform the spreading operation so that planting can proceed with little additional tillage or soil preparation. Leave the area smooth, suitable for lawn planting.

C. Maintenance. Where any portion of the surface becomes eroded or otherwise damaged, repair the affected area to establish the condition and grade prior to topsoil placement; then replace topsoil.

3.10 FINAL GRADING

A. After other work has been completed except for exactness of finish as required, roadway shoulders, slopes and ditches shall be smoothly shaped.

B. Ditches and channels shall be cleared of debris and obstructions.

C. Excess earth or other waste material adjacent to structures, poles, trees or other objects shall be leveled down or otherwise disposed of as required.

D. Loose stones, rocks and boulders within the project site that would fail to pass a 2-inch ring shall be removed and disposed of as required.

E. Roots, trash and other debris shall be removed from Owner's property.

F. Dragging, pushing or scraping of material along or across the surface of completed pavement shall not be permitted.

G. Continuously maintain sections until acceptance of work.

H. Grades shown are minimum elevation. Finish surface shall not more than 0.10 feet below established grade or cross section.

I. Finish ditches and gutters to drain readily.

J. Where existing grade is disturbed in areas not marked to be graded, re-grade disturbed area to original grade.

3.11 TESTING

A. Laboratory Services. Owner shall appoint a commercial testing laboratory to assess adequacy of materials and compaction as outlined in Section 01455, Testing Laboratory Services.

B. Testing Requirements.

C. Perform sufficient testing to ensure that the fill for levee construction is being constructed as specified. The testing program specified below shall be considered the minimum acceptable frequency of testing. This does not relieve the Contractor from the responsibility of performing additional testing, if required to ensure compliance with these specifications.

1. Perform soil classification tests for Levee embankment soils in accordance with ASTM D2487.
2. Prepare optimum moisture/density relationship for subgrade in accordance with AASHTO T99 (ASTM D 698).
3. Test compacted general fill embankment and backfill as follows:
4. One field density test minimum for every 1000 cubic yards of material placed in compliance with ASTM D 1556 or D 2922.
5. Four random field density tests minimum of backfill at each culvert, abutment and similar locations in compliance with ASTM D 1556 or D 2927.

END OF SECTION

SECTION 02226

EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Excavation, backfilling, and compaction of backfill for structures.

1.02 UNIT PRICES

A. No payment will be made for structural excavation and backfill under this Section. Include payment in unit price or lump sum for applicable bid item.

1.03 DEFINITIONS

A. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that are classified as ML, CL-ML, MH, PT, OH and OL according to ASTM D 2487.

2. Materials that cannot be compacted to the required density due to gradation, plasticity, or moisture content.

3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.

4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.

C. Select Material: Material as defined in Section 02229 - Utility Backfill Materials.

D. Backfill: Select material meeting specified quality requirements, placed and compacted under controlled conditions around structures.

E. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics, as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for the structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

F. Foundation Base: For foundation base material, use crushed aggregate with filter fabric, as required, cement stabilized sand, or concrete seal slab. The foundation base provides a smooth, level working surface for the construction of the concrete foundation.

G. Foundation Subgrade: Foundation subgrade is the surface of the natural soil which has been excavated and prepared to support the foundation base or foundation backfill, where needed.

H. Ground Water Control Systems: Installations external to the excavation such as well points, eductors, or deep wells. Ground water control includes dewatering to lower the ground water, intercepting seepage which would otherwise emerge from the side or bottom of the excavation, and depressurization to prevent failure or heaving of the excavation bottom. Refer to Section 01563 - Control of Ground Water and Surface Water.

I. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from the excavation. Remove rain water and surface water which accidentally enters the excavation as a part of excavation drainage.

J. Excavation Drainage: Removal of surface and seepage water in the excavation by sump pumping and using French drains surrounding the foundation to intercept the water.

K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below the foundation as shown on Drawings, and backfilled with foundation backfill material.

L. Shoring System: A structure that supports the sides of an excavation to maintain stable soil conditions and prevent cave-ins.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these regulations.

B. Submit a work plan for excavation and backfill for each structure with complete written description which identifies details of the proposed method of construction and the sequence of operations for construction relative to excavation and backfill activities. The descriptions, with supporting illustrations, shall be sufficiently detailed to demonstrate to the Owner’s Representative that the procedures meet the requirements of the Specifications and Drawings.

C. Submit excavation safety system plan.

1. The excavation safety system plan shall be in accordance with applicable OSHA requirements for all excavations.

2. The excavation safety system plan shall be in accordance with the requirements of Section 01526 - Trench Safety System, for all excavations that fall under State and Federal trench safety laws.

D. Submit a ground and surface water control plan in accordance with requirements in this Section and Section 01563 - Control of Ground Water and Surface Water.

E. Submit backfill material sources and product quality information in accordance with requirements of Section 02229 - Utility Backfill Materials.

F. Submit project record documents under provisions of Section 01720 - Project Record Documents. Record location of utilities, as installed, referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

1.05 TESTS

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the Owner in accordance with requirements of Section 01410 - Testing Laboratory Services and as specified in this Section.

B. Contractor shall perform embedment and backfill material source qualification testing in accordance with requirements of Section 02229- Utility Backfill Materials.

PART 2 P R O D U C T S

2.01 EQUIPMENT

A. Perform excavation with equipment suitable for achieving the requirements of this Specification.

B. Use equipment which will produce the degree of compaction specified. Backfill within 3 feet of walls shall be compacted with hand-operated equipment. Do not use equipment weighing more than 10,000 pounds closer to walls than a horizontal distance equal to the depth of the fill at that time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

2.02 MATERIAL CLASSIFICATIONS

A. Backfill materials shall conform to the classifications and product descriptions of Section 02229 - Utility Backfill Materials. The classification or product description for backfill applications shall be as shown on the Drawings and as specified.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Conduct an inspection to determine condition of existing structures and other permanent installations.

B. Set up necessary street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01570 - Traffic Control and Regulation. Maintain barricades and warning devices at all times for streets and intersections where work is in progress, or where affected by the Work, and is considered hazardous to traffic movements.

C. Perform work in accordance with OSHA standards. Employ an excavation safety system as specified in Section 01526 - Trench Safety Systems for excavations over 5 feet deep.

D. Remove old pavements and structures, including sidewalks and driveways, in accordance with requirements of Section 02076 - Removing Existing Pavements and Structures.

E. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01563 - Control of Ground Water and Surface Water.

3.02 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within the grading limits as designated on the Drawings, and in accordance with requirements of Section 01535 - Tree and Plant Protection.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on the Drawings.

D. Prevent erosion of excavations and backfill. Do not allow water to pond in excavations.

E. Maintain excavation and backfill areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no additional cost to the Owner.

3.03 EXCAVATION

A. Perform excavation work so that the underground structure can be installed to depths and alignments shown on Drawings. Use caution during excavation work to avoid

disturbing surrounding ground and existing facilities and improvements. Keep excavation to the absolute minimum necessary. No additional payment will be made for excess excavation not authorized by Owner's Representative.

B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work. Notify Owner's Representative and obtain instructions before proceeding in such areas.

C. Immediately notify the agency or company owning any line which is damaged, broken or disturbed. Obtain approval from Owner's Representative and agency for any repairs or relocations, either temporary or permanent.

D. Avoid settlement of surrounding soil due to equipment operations, excavation procedures, vibration, dewatering, or other construction methods.

E. Provide surface drainage during construction to protect work and to avoid nuisance to adjoining property. Where required, provide proper dewatering and piezometric pressure control during construction.

F. Conduct hauling operations so that trucks and other vehicles do not violate the City's Stormwater Protection Ordinance. Verify that truck beds are sufficiently tight and loaded in such a manner that material will not spill onto streets. Promptly clear away any dirt, mud, or other materials that spill onto streets or are deposited onto streets by vehicle tires.

G. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed, replace those which are damaged or destroyed by the Work.

H. Provide sheeting, shoring, and bracing where required to safely complete the Work, to prevent excavation from extending beyond limits indicated on Drawings, and to protect the Work and adjacent structures or improvements. Sheeting, shoring, and bracing used to protect workmen and the public shall conform to requirements of Section 01526 - Trench Safety Systems.

I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, concrete fill, cement stabilized sand, or other material approved by Owner's Representative.

J. After completion of the structure, remove sheeting, shoring, and bracing unless Owner's Representative has approved in writing that such temporary structures may remain. Remove sheeting, shoring and bracing in such a manner as to maintain safety during backfilling operations and to prevent damage to the Work and adjacent structures or improvements.

K. Immediately fill and compact voids left or caused by removal of sheeting with cement stabilized sand or material approved by Owner's Representative.

3.04 HANDLING EXCAVATED MATERIALS

A. Classify excavated materials. Place material which is suitable for use as backfill in orderly piles at a sufficient distance from excavation to prevent slides or cave-ins.

B. Provide additional backfill material in accordance with requirements of Section 02229 - Utility Backfill Materials, if adequate quantities of suitable material are not available from excavation and trenching operations at the site.

3.05 DEWATERING

A. Provide ground water control per Section 01563 - Control of Ground Water and Surface Water.

B. Maintain the ground water surface a minimum of two feet below the bottom of the foundation base.

C. Maintain ground water control as directed by Section 01563 - Control of Ground Water and Surface Water and until the structure is sufficiently complete to provide the required weight to resist hydrostatic uplift with a minimum safety factor of 1.2.

3.06 FOUNDATION EXCAVATION

A. Notify Owner's Representative at least 48 hours prior to planned completion of foundation excavations. Do not place the foundation base until the excavation is accepted by the Owner's Representative.

B. Excavate to elevations shown on Drawings, as needed to provide space for the foundation base, forming a level undisturbed surface, free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or a material as directed by the Owner's Representative. Prior to placing material over it, recompact the subgrade, scarifying, as needed, to 95 percent of the maximum Standard Proctor Density according to ASTM D 698. If the specified level of compaction cannot be achieved, moisture condition the subgrade and recompact until 95 percent is achieved, over-excavate to provide a minimum layer of 24 inches of foundation backfill material, or other means acceptable to the Owner's Representative.

C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by the Owner's Representative.

D. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in a satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement.

E. Soils which become unsuitable due to inadequate dewatering or other causes, after initial excavation to the required subgrade, shall be removed and replaced with foundation backfill material, as directed by Owner's Representative, at no additional cost to the Owner.

F. Place foundation base, or foundation backfill material, where needed, over the subgrade on same day that excavation is completed to final grade. Where base of excavations are left open for longer periods, protect them with a seal slab or cement-stabilized sand.

G. All crushed aggregate, and other free draining Class I materials, shall have a geotextile filter fabric separating it from native soils or select material backfill. The fabric shall overlap a minimum of 12 inches beyond where another material stops contact with the soil.

H. Crushed aggregate, and other Class I materials, shall be placed in uniform layers of 8-inch maximum thickness. Compaction shall be by means of at least two passes of a vibratory compactor.

3.07 FOUNDATION BASE

A. After the subgrade is properly prepared, including the placement of foundation backfill where needed, the foundation base shall be placed. The foundation base shall consist of a 12-inch layer of crushed aggregate or cement stabilized sand. Alternately, a 4-inch minimum seal slab may be placed. The foundation base shall extend a minimum of 12 inches beyond the edge of the structure foundation. Refer to the project plans and comply with actual design requirement when more stringent than stated herein.

B. Where the foundation base and foundation backfill are of the same material, both can be placed in one operation.

3.08 BACKFILL

A. Complete backfill to surface of natural ground or to lines and grades shown on Drawings. Use existing material that qualifies as select material, unless indicated otherwise. Deposit backfill in uniform layers and compact each layer as specified.

B. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that the concrete has reached a minimum of 85 percent of the specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill operations until the slab or intermediate walls have been placed and concrete has attained sufficient strength.

C. Remove concrete forms before starting backfill and remove shoring and bracing as work progresses.

D. Maintain fill material at no less than 2 percent below nor more than 2 percent above optimum moisture content. Place fill material in uniform 8-inch maximum loose layers. Compaction of fill shall be to at least 95 percent of the maximum Standard Proctor Density according to ASTM D 698 under paved areas. Compact to at least 90 percent around structures below unpaved areas.

E. Where backfill is placed against a sloped excavation surface, run compaction equipment across the boundary of the cut slope and backfill to form a compacted slope surface for placement of the next layer of backfill.

F. Place backfill using cement-stabilized sand in accordance with Section 02252 - Cement Stabilized Sand.

3.09 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Tests will be performed initially on minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is a noticeable change in material gradation or plasticity.

C. In-place density tests of compacted subgrade and backfill will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at the following frequencies and conditions:

1. A minimum of one test for every 100 cubic yards of compacted backfill material.

2. A minimum three density tests for each full work shift.

3. Density tests will be performed in all placement areas.

4. The number of tests will be increased if inspection determines that soil types or moisture contents are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density.

D. At least three tests for moisture-density relationships will be initially performed for each type of backfill material in accordance with ASTM D 698. Additional moisture-density relationship tests will be performed whenever there is a noticeable change in material gradation or plasticity.

E. If tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

3.10 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess materials in accordance with requirements of Section 01564 - Waste Material Disposal.

END OF SECTION

SECTION 02227

EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities.

1.2 UNIT PRICES

A. No additional payment will be made for trench excavation, embedment and backfill. Include payment in the unit price for applicable bid items.

B. No separate or additional payment will be made for surface water control, or for excavation drainage. Include payment in the unit price for applicable bid items.

1.3 DEFINITIONS

A. Pipe Foundation: Suitable and stable native soils that are exposed at the trench subgrade after excavation to depth of bottom of the bedding as shown on the Drawings, or foundation backfill material placed and compacted in over-excavations.

B. Pipe Bedding: The portion of trench backfill that extends vertically from top of foundation up to a level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.

C. Haunching: The material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.

D. Initial Backfill: The portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to a level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.

E. Pipe Embedment: The portion of trench backfill that consists of bedding, haunching and initial backfill.

F. Trench Zone: The portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.

G. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that are classified as ML, CL-ML, MH, PT, OH and OL according to ASTM D 2487.
2. Materials that cannot be compacted to required density due to either gradation, plasticity, or moisture content.
3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

H. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement are considered suitable, unless otherwise indicated.

I. Backfill: Suitable material meeting specified quality requirements, placed and compacted under controlled conditions.

J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Section 01563 - Control of Ground Water and Surface Water.

K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as a part of excavation drainage.

L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using a drainage layer, as defined in ASTM D 2321, placed on the foundation beneath pipe bedding or thickened bedding layer of Class I material.

M. Trench Conditions are defined with regard to the stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.
1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as a result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
    a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to

control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.

b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in the embedment zone in combination with ground water control in predominately sandy or silty soils.

3. Unstable Trench: Unstable trench conditions exist in the pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.

N. Subtrench: Subtrench is a special case of benched excavation. Subtrench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of a subtrench depends upon trench stability and safety as determined by the Contractor.

O. Trench Dam: A placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along the trench.

P. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.

Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.

R. Trench Safety Systems include both Protective Systems and Shoring Systems as defined in Section 01526 - Trench Safety Systems.

S. Trench Shield (Trench Box): A portable worker safety structure moved along the trench as work proceeds, used as a Protective System and designed to withstand forces imposed on it by cave-in, thereby protecting persons within the trench. Trench shields may be stacked if so designed or placed in a series depending on depth and length of excavation to be protected.

T. Shoring System: A structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movements of the ground affecting adjacent installations or improvements.

1.4 SCHEDULING

A. Schedule work so that pipe embedment can be completed on the same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

1.5 SUBMITTALS

A. Submittals shall conform to the requirements of all provisions and sections of these specifications.

B. Submit a written description for information only of the planned typical method of excavation, backfill placement and compaction, including:
1. Sequence of work and coordination of activities.
2. Selected trench widths.
3. Procedures for foundation and embedment placement, and compaction.
4. Procedure for use of trench boxes and other premanufactured systems while assuring specified compaction against undisturbed soil.
5. Procedure for installation of Special Shoring at locations identified on the Drawings.

C. Submit a ground and surface water control plan in accordance with requirements in this Section and Section 01563 - Control of Ground Water and Surface Water.

D. Submit backfill material sources and product quality information in accordance with requirements of Section 02229 - Utility Backfill Materials.

E. Submit a trench excavation safety program in accordance with requirements of Section 01526 - Trench Safety System. Include designs for special shoring meeting the requirements defined in Paragraph 1.03 of Section 01526.

F. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.

1.6 TESTS

A. Perform backfill material source qualification testing in accordance with requirements of Section 02229 - Utility Backfill Materials.

B. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the Owner in accordance with requirements of Section 01410 - Testing Laboratory Services and as specified in this Section.

1.7 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within the grading limits as designated on the Drawings, and in accordance with requirements of Section 01535 - Tree and Plant Protection.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities are indicated on the Drawings.

1.8 SPECIAL SHORING DESIGN REQUIREMENTS

A. Have Special Shoring designed or selected by the Contractor's Professional Engineer to provide support for the sides of the excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a premanufactured system selected by the Contractors Professional Engineer to meet the project site requirements based on the manufacturer's standard design.

PART 2 P R O D U C T S

2.1 EQUIPMENT

A. Perform excavation with hydraulic excavator or other equipment suitable for achieving the requirements of this Section.

B. Use only hand-operated tamping equipment until a minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.

C. Use trench shields or other Protective Systems or Shoring Systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.

D. Use Special Shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting the Special Shoring design requirements.

2.2 MATERIAL CLASSIFICATIONS

A. Embedment and Trench Zone Backfill materials: Conform to the classifications and product descriptions of Section 02229 - Utility Backfill Materials.

B. Concrete Backfill: Conform to requirements for Class B concrete as specified in the pertinent Section.

P. Geotextile (Filter Fabric): Conform to requirements of Section 02249 - Geotextile.

Q. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

E. Timber Shoring Left in Place: Untreated oak.

PART 3 E X E C U T I O N

3.1 STANDARD PRACTICE

A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between the standard practice and the requirements of this Section, this Section governs.

B. Install rigid pipe to conform with standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between the standard practice and the requirements of this Section, this Section governs.

3.2 PREPARATION

A. Establish traffic control to conform with requirements of Section 01570 - Traffic Control and Regulation. Maintain barricades and warning lights for streets and intersections where Work is in progress or where affected by the Work, and is considered hazardous to traffic movements.

B. Perform Work to conform with applicable safety standards and regulations. Employ a trench safety system as specified in Section 01526 - Trench Safety Systems.

C. Immediately notify the agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from the Owner’s Representative and agency for any repairs or relocations, either temporary or permanent.

D. Remove existing pavements and structures, including sidewalks and driveways, to conform with requirements of Section 02076 - Removing Existing Pavements and Structures, as applicable.

E. Install and operate necessary dewatering and surface water control measures to conform with Section 01563 - Control of Ground Water and Surface Water.

F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Section 01050 - Field Surveying.

G. PREPARATION: Complete, as incidental to construction, site preparation work including clearing and grubbing; removal and disposal of trash, rubbish, debris, and minor obstacles to construction; relocation of savable items; stripping topsoil within excavation areas, stockpiling topsoil; and, after construction, spreading topsoil over disturbed areas as required and finishing and grading surface within construction areas.

H. Perform a Potential Conflict Investigation at all critical locations. Locate existing utilities ahead of pipe laying activities. Notify Owner's Representative in writing immediately upon identification of any conflict. In the event, Contractor will not be entitled to extra cost for downtime including, but not limited, payroll, equipment, overhead demobilization and remobilization.

3.3 EXCAVATION

A. Except as otherwise specified or shown on the Drawings, install underground utilities in open cut trenches with vertical sides.

B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on the Drawings. Avoid disturbing surrounding ground and existing facilities and improvements. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadways or detours with stockpiled materials.

C. Determine trench excavation widths using the following schedule (as a minimum) as related to pipe outside diameter (O.D.) Or as shown on the drawings. Maximum trench width shall be the minimum trench width plus 24 inches.

Nominal Pipe Size, Inches	Minimum Trench Width, Inches
Less than 18	O.D. + 18
18 to 30	O.D. + 24
Greater than 30	O.D. + 36

D. Use sufficient trench width or benches above the embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from the surface elevation. Provide sufficient

space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.

E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify the Owner's Representative and obtain instructions before proceeding.

F. Shoring of Trench Walls.

1. Install Special Shoring in advance of trench excavation or simultaneously with the trench excavation, so that the soils within the full height of the trench excavation walls will remain fully laterally supported at all times.
2. For all types of shoring, support trench walls in the pipe embedment zone throughout the installation. Provide trench wall supports sufficiently tight to prevent washing the trench wall soil out from behind the trench wall support.
3. Unless otherwise directed by the Owner's Representative, leave sheeting driven into or below the pipe embedment zone in place to preclude loss of support of foundation and embedment materials. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and the trench wall in the vicinity of the pipe zone.
4. Employ special methods for maintaining the integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
5. If sheeting or other shoring is used below top of the pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into the embedment zone 1 inch. Fill voids left on removal of supports with compacted backfill material.

G. Use of Trench Shields. When a trench shield (trench box) is used as a worker safety device, the following requirements apply:

1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to the trench sidewalls.
2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor the degree of compaction reduced.
3. When required, place, spread, and compact pipe foundation and bedding materials beneath the shield. For backfill above bedding, lift the shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
4. Maintain trench shield in position to allow sampling and testing to be performed in a safe manner.

H. Cover:

1. Provide 24 in. Minimum cover over top of pipe where surface grades are definitely established and 30 in. in other locations.
2. Greater depth of cover may be necessary on vertical curves or to provide necessary clearance beneath pipes, conduits, drains, drainage structures or other obstructions encountered at normal pipe grades.
3. For water mains, provide 4 ft. minimum cover unless noted otherwise.
4. Measure depth of backfill cover vertically from top of pipe to finish ground or pavement surface elevations.

I. Trenching:
1. Excavation for pipe stubs to be laid transversely across streets may be made with trench hoe.
2. Where surface or underground obstructions make excavation inaccessible to trenching machine, trench hoe may be used.
3. Where trench hoe is used, do not use excavated material composed of large chunks and clods for backfill.
4. No excavated material will be stockpiled along trench or on paved surfaces. Load excavated material into dump truck as trench is excavated.
5. Topsoil excavated from the trench shall be returned to trench to be used as backfill material for the top 12 inches of the trench.
6. For trench excavations requiring cement stabilized sand backfill to subgrade of pavement, stockpiling of cement stabilized sand on pavement is not permitted.

J. Voids under paving area outside shield will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports.

K. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.

L. Do not use excavators with side cutters installed while working within 15 feet of pipeline company's pipeline. Use a small, rubber-tired excavator, such as a backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have a guard installed over teeth to approximate a bucket without teeth. Excavate by hand within 1 foot of pipeline company's line. Do not use larger excavation equipment normally used to dig water main trench in vicinity of pipeline until all pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by pipeline company's representative.

M. Regrade adjacent ground surfaces where surfaces have been disturbed during construction operations to original and matching grades.

N. Trees and shrubs designated to remain that sustain cutting or injury to roots, trunk , or limbs shall be pruned by a tree surgeon and cut or injury painted with asphaltic horticultural coating without cost to Owner.

O. Perform repair on pipe in locations shown on plans/specifications.

P. Where pipe is to be installed in fill, complete area fill and compaction to an elevation not less than 1 ft. above top of pipe before open-cut excavation and trenching for pipe.

Q. Excavate adequate but not excessive working space and clearances for installation of work and form removal.

R. Allow not less than 6 in. clearance in horizontal dimensions of excavations for outside plastering of manholes and similar structures constructed of masonry units.

S. Do not undercut excavation faces for extended footings of structures.

T. Excavate by hand within 2 ft. of existing utility to remain.

U. BLASTING: Use of explosions will not be permitted.

V. UNAUTHORIZED EXCAVATION: Refill excavation below subgrade elevations with tamped sand, gravel, cement stabilized sand, or concrete.

3.4 HANDLING EXCAVATED MATERIALS

A. Use only excavated materials which are suitable as defined in this Section and conforming with Section 02229 - Utility Backfill Materials. Place material suitable for backfilling in stockpiles at a distance from the trench to prevent slides or cave-ins.

B. When required, provide additional backfill material conforming with requirements of Section 02229 - Utility Backfill Materials.

C. Do not place stockpiles of excavated materials on streets and adjacent properties. Maintain site conditions in accordance with Section 01500 - Temporary Facilities and Controls.

D. Dispose of unsuitable excavated materials off-site in legal manner.

E. Excess excavated material shall become the property of the contractor to be disposed of off-site in a legal manner.

3.5 GROUND WATER CONTROL

A. Implement ground water control according to Section 01563 - Control of Ground Water and Surface Water. Provide a stable trench to allow installation in accordance with the Specifications.

3.6 TRENCH FOUNDATION

A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.

B. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes, and not less than one in every 300 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

C. Where rock or other incompressible material is encountered, remove material to depth 6 in. below subgrade and backfill with tamped sand, gravel, or concrete.

D. Reinforce trench bottoms or subgrade surfaces for concrete structures which are solid, but which become mucky on top due to construction operations with specified sand.

E. Use only tamped sand, gravel, or concrete to bring fills to lines and grades indicated and for replacing unsatisfactory materials.

3.7 PIPE EMBEDMENT PLACEMENT AND COMPACTION

A. Immediately prior to placement of embedment materials, the bottoms and sidewalls of trenches shall be free of loose, sloughing, caving, or otherwise unsuitable soil.

B. Place geotextile to prevent particle migration from the in-situ into open-graded (Class I) embedment materials or drainage layers.

C. Place embedment including bedding, haunching and initial backfill to meet requirements indicated on Drawings.

D. For pipe installation, manually spread embedment materials around the pipe to provide uniform bearing and side support when compacted. Do not allow materials to free-fall from heights greater than 24 inches above top of pipe. Perform placement and

compaction directly against the undisturbed soils in the trench sidewalls, or against sheeting which is to remain in place.

E. Do not place trench shields or shoring within height of the embedment zone unless means to maintain the density of compacted embedment material are used. If moveable supports are used in embedment zone, lift the supports incrementally to allow placement and compaction of the material against undisturbed soil.

F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.

G. Place haunching material manually around the pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside the pipe with sand bags or other suitable means.

H. Place electrical conduit directly on foundation without bedding.

I. Shovel pipe embedment material in place and compact it using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of the next lift.
   1. Class I embedment materials.
      a. Maximum 6-inches compacted lift thickness.
      b. Systematic compaction by at least two passes of vibrating equipment. Increase compaction effort as necessary to effectively embed the pipe to meet the deflection test criteria.
      c. Moisture content as determined by Contractor for effective compaction without softening the soil of trench bottom, foundation or trench walls.
   2. Class II embedment and cement stabilized sand.
      a. Maximum 6-inches compacted thickness.
      b. Compaction by methods determined by Contractor to achieve a minimum of 95 percent of the maximum dry density as determined according to ASTM D 698 for Class II materials and according to ASTM D 558 for cement stabilized materials.
      c. Moisture content of Class II materials within 3 percent of optimum as determined according to ASTM D 698. Moisture content of cement stabilized sands on the dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.

J. Place trench dams in Class I embedment's in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional

dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.8 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only the minimum length of trench open as necessary for construction.

B. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave the sheeting in place. Cut off sheeting 1.5 feet or more above the crown of the pipe. Remove trench supports within 5 feet from the ground surface.

C. For sewer pipes, use backfill materials described here as determined by trench limits. As trench zone backfill in paved areas for streets and to one foot back of curbs and pavements, use cement stabilized sand for pipe of nominal sizes less than 36 inches, or bank run sand for pipe of nominal sizes 36 inches and larger or as indicated on the Drawings. Uniformly backfill trenches partially within limits one foot from streets and curbs according to the paved area criteria. Use select backfill within one foot below pavement subgrade for rigid pavement. For asphalt concrete or limestone roadway, use flexible base material within one foot below pavement subgrade.

D. For water lines, backfill in trench zone, including auger pits, with bank run sand, select fill material as specified in Section 02229 - Utility Backfill materials.

E. For trench excavations under pavement, place trench zone backfill in lifts and compact by methods indicated below or as stated on the plans. Fully compact each lift before placement of the next lift.
   1. Bank run sand.
      a. Maximum 9-inches compacted lift thickness.
      b. Compaction by vibratory equipment to a minimum of 95 percent of the maximum dry density determined according to ASTM D 698.
      c. Moisture content within 3 percent of optimum determined according to ASTM D 698
   2. Cement-stabilized sand.
      a. Place backfill in 8 in. maximum layers to achieve uniform placement and required compaction.
      b. Compaction by vibratory equipment to a minimum of 95 percent of the maximum dry density determined according to ASTM D 558.
      c. Moisture content on the dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.
   3. Select fill
      a. Maximum 6-inches compacted thickness.

b. Compaction by equipment providing tamping or kneading impact to a minimum of 95 percent of the maximum dry density determined according to ASTM D 698.
c. Moisture content within 2 percent of optimum determined according to ASTM D 698.
d. Add backfill material as necessary where backfill settled below ground surface.

F. Do not backfill with wet, mucky, or unsuitable materials or with large rocks or clods of material.

G. Trench backfill above pipe embedment shall conform to requirements for type and location of pipe as shown on the drawing.

H. Place backfill material to minimum depth 12 in. above pipe before ceasing backfilling operations for day.

I. Base Material Backfill for Patching of Existing Pavement: Provide 12 in. of base material.

J. Flooding of backfill for compaction (water tamping) is not acceptable. Obtain compaction by mechanical means which allows access to all areas of backfill.

3.9 MANHOLES, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES

A. Meet the requirements of adjoining utility installations for backfill of pipeline structures, as shown on the Drawings.

3.10 FIELD QUALITY CONTROL

A. Test for material source qualifications as defined in Section 02229 - Utility Backfill Materials.

B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction.

C. Laboratory Quality Control by Contractor:
1. Establish optimum moisture-maximum density curve for bedding and backfill material, ASTM D 698.
a. For those soils which will not exhibit a well defined moisture-density relationship, determine maximum and minimum index densities of the soil, ASTM D4253 and D4254, for calculation of the relative density of the soil in the field.

2. Establish optimum moisture-maximum density curve, ASTM D 698; Atterberg Limits, ASTM D 4318; and sieve analysis, ASTM D 422 for the following:
   a. Borrow bedding and backfill material to be used.
   b. Excavated material of questionable suitability for use as bedding and backfill material.
3. One optimum moisture-maximum density curve, ASTM D 698, shall be established for each significant change in materials.
4. Bedding and backfill materials which do not meet specified requirements shall be replaced with suitable materials.

D. Field Quality Control by Owner
1. Laboratory density testing of trench backfill:
   a. One field in-place density test per 500 linear ft. of trench for each fill layer.
   b. One field in-place density test per 150 linear ft. of trench for each fill layer under existing or proposed paved areas and at least one test per fill layer at each road crossing.
2. Laboratory density testing of general fill: One field in-place density test per 100 cu. yds. of fill placed.
3. Field in-place density tests shall be in compliance with ASTM D 1556, ASTM D 2922, or ASTM D 2167.

E. Submit minimum 10 lb. Samples of any borrow bedding and backfill material to be used to materials testing laboratory.

F. Recondition, recompact, and retest at Contractor's expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor's expense.

G. Acceptability of crushed rock compaction will be determined by inspection.

3.11 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess materials in accordance with requirements of Section 01564 - Waste Material Disposal.

3.12 PRE-CONSTRUCTION INVESTIGATION BY CONTRACTOR (**NO SEPARATE PAY**)

A. See Specification 01060.

END OF SECTION

SECTION 02228

EXTRA UNIT PRICE WORK FOR EXCAVATION AND BACKFILL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Measurement and payment applicable to extra Work items required for utility installations which are identified in the Proposal Form, and which have been authorized in advance by the Owner's Representative and made necessary by unusual or unforeseen circumstances encountered during utility excavation.

1.02 UNIT PRICES

A. Special excavation: Measurement for special excavation is on a cubic yard basis, measured in place, without deduction for space occupied by portions of pipes, ducts, or other structures left in place across trenches excavated under this item.

1. Cost for item shall include:

a. Dewatering and surface water control.

b. Protection of pipes, ducts, or other structures encountered including bracing, shoring, and sheeting necessary for support.

c. Replacement of pipes, ducts, or structures damaged by special excavation operations, except where payment for replacement is authorized by Owners Representative due to deteriorated condition of pipes, ducts, or structure.

d. Temporary disconnecting, plugging, and reconnecting of low volume water pipes, to allow machine excavation or augering, when approved by Owner's Representative. Pipe for replacement shall be new and conform to specification requirements for type of existing pipe removed.

e. Resodding required for surface restoration within designated limits of special excavation.

f. Disposal of excess excavated material not suitable for bedding or backfill, or not required for the Project.

2. Include cost for following items in payment for applicable Division 2 Sections:

a. Trench safety system including sheeting and shoring.

b. Utility piping installed in trenches excavated under this item.

c. Removal and replacement of associated streets, driveways, and sidewalks.

B. Extra hand or machine excavation: Measurement for extra hand excavation is on a cubic yard basis, measured in place.

1. Cost for item shall include:

a. Dewatering and surface water control.

b. Disposal of excess excavated material not suitable for bedding or backfill, or not required for the Project.

2. Include cost for placement of extra hand excavation in payment for Extra Work Bid Item for Extra Placement of Material.

3. Include cost for following items in payment for applicable Division 2 Sections:

a. Trench safety system including sheeting and shoring.

b. Removal and replacement of associated streets, driveways, and sidewalks.

C. Extra placement of material:

1. Measurement for extra placement of material is on a cubic yard basis, measured in place. At the discretion of Owner's Representative, measurement of cubic yards may be calculated from the volume of Extra Hand Excavation or Extra Machine Excavation for which placement is made, minus the volume of any Extra Placement of Special Backfill authorized in conjunction with the Work.

2. Cost for this item shall include resodding required for surface restoration within designated limits of Extra Hand Excavation or Extra Machine Excavation.

D. Extra placement of special excavation:

1. Measurement for extra placement of special material is on a cubic yard basis, measured in place.

2. Cost for this item shall include geotextile material and concrete trench dams required to complete the placement of special material conforming to the Specifications.

E. No payment will be made for delays in completion of Work resulting from extra unit price Work.

F. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Special excavation: Excavation necessitated by obstruction of pipes, ducts, or other structures, not shown on Drawings, which interfere with installation of utility piping by normal methods of excavation or augering. Contractor shall be responsible for locating such underground obstructions, sufficiently in advance of trench excavation or augering, to preclude damage to the obstructions.

B. Extra hand excavation: Excavation by manual labor at locations designated by the Owner Representative, which is not included in, or is incidental to, bid items contained in the Schedule of Unit Prices.

C. Extra machine excavation: Excavation by machine at locations designated by the Owner Representative, which is not included in, or is incidental to, bid items contained in the Schedule of Unit Prices.

D. Extra replacement of material: Handling, backfill, and compaction of excavated material authorized under Extra Work Bid Items for Extra Hand Excavation or Extra Machine Excavation. Placement and compaction shall conform to requirements specified in appropriate Division 2 Sections.

E. Extra placement of special backfill: Hauling, placing, and consolidating of special materials in conjunction with Extra Work Bid Item Extra Replacement of Material at locations designated by the Owner's Representative. Materials placed under this item shall conform to requirements for Bank Run Sand, Cement Stabilized Sand, Concrete Sand, Pea Gravel, Gem Sand, or Crushed Stone specified in Division 2 Sections.

PART 2 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N - NOT USED

END OF SECTION

SECTION 02229

UTILITY BACKFILL MATERIALS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Material Classifications

B. Utility Backfill Materials

1. Concrete sand.

2. Gem sand.

3. Pea gravel.

4. Crushed stone.

5. Crushed concrete.

6. Bank run sand.

7. Select backfill.

8. Random backfill.

C. Material handling and quality control requirements.

1.02 UNIT PRICES

A. No payment will be made for backfill material unless specifically listed in the Proposal Form. Include payment in unit price for applicable utility installation.

B. Measurement for backfill material, when included as a separate pay item, is on a cubic yard basis for material placed and compacted within theoretical trench width limits and thickness of material according to Drawing details.

C. Measurement for backfill of authorized over-excavation is in accordance with Section 02228 - Extra Unit Price Work for Excavation and Backfill.

D. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Backfill: Suitable material meeting specified quality requirements for the designated application as embedment or trench zone backfill.

B. Embedment: Material placed under controlled conditions within the embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.

C. Trench Zone Backfill: Material meeting specified quality requirements and placed under controlled conditions in the trench zone from top of embedment zone to base course in paved areas or to the surface grading material in unpaved areas.

D. Foundation: Either suitable soil of the trench bottom, or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.

E. Source: A source selected by the Contractor for supply of embedment or trench zone backfill material. A selected source may be the project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.

F. Refer to Section 02227 - Excavation and Backfill for Utilities, for other definitions regarding utility installation by trench construction.

1.04 SUBMITTALS

A. Conform to requirements of all sections and provisions of these specifications.

B. Submit a description of source, material classification and product description, production method, and application of backfill materials.

C. Submit test results for samples of off-site backfill materials to comply with Paragraph 3.03, Material Quality Control.

D. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that the Owner’s Representative may obtain samples for verification testing.

E. Before stockpiling materials, submit a copy of temporary easement or approval from landowner for stockpiling backfill material on private property.

1.05 TESTS

A. Perform tests of sources for backfill material in accordance with Paragraph 3.03A of this section.

B. Verification tests of backfill materials may be performed by the Owner in accordance with Section 01410 - Testing Laboratory Services and in accordance with Paragraph 3.03B of this section.

C. Random fill obtained from the Project excavation as source is exempt from prequalification requirements by Contractor, but must be inspected for unacceptable materials based on ASTM D 2488.

PART 2 P R O D U C T S

2.01 MATERIAL CLASSIFICATIONS

A. Materials for backfill shall be classified for the purpose of quality control in accordance with the Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02 of this section.

B. Class Designations Based on Laboratory Testing:

1. Class I: Well graded sands and gravels, gravel-sand mixtures, crushed well graded rock, little or no fines (GW, SW)

   a. Plasticity Index: Nonplastic

   b. Gradation: D_{60}/D_{10} - greater than 4 percent. Amount passing No. 200 Sieve - less than or equal to 5 percent

2. Class II: Poorly graded gravels and sands, silty sands and gravels, little to moderate fines (GM, GP, SP, SM)

   a. Plasticity Index: Nonplastic to 4

   b. Gradation (GP, SP): Amount passing No. 200 Sieve - less than 5 percent

   c. Gradation (GM, SM): Amount passing No. 200 Sieve - between 12 percent and 50 percent

3. Class III: Clayey gravels and sands, poorly graded mixtures of sand, gravel, and clay (GC, SC)

   a. Plasticity Index: greater than 7

   b. Gradation: Amount passing No. 200 Sieve - between 12 percent and 50 percent

4. Class IV: Lean clays (CL)

   a. Plasticity Index: greater than 7

   b. Liquid Limit: less than 50

   c. Gradation: Amount passing No. 200 Sieve - greater than 50 percent

   d. Inorganic

5. Use soils with dual class designation according to ASTM D 2487 according to the more restrictive class.

2.02 PRODUCT DESCRIPTIONS

A. Soils classified as silt (ML), silty clay (CL - ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Owner's Representative. Soils classified as fat clay (CH) may be used as backfill materials where allowed by the applicable backfill installation specification. Refer to Section 02226 - Excavation and Backfill for Structures and Section 02227 - Excavation and Backfill for Utilities.

B. Provide backfill material that is free of stones greater than 3 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to the following limits for deleterious materials:

   1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.

   2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.

   3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.

C. Manufactured materials may be substituted for natural soil or rock products where indicated in the product specification, and approved by Owner's Representative, provided that the physical property criteria are determined to be satisfactory by testing.

D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by the Unified Soil Classification System (ASTM D 2487) meeting the following requirements:

1. Less than 15 percent passing the number 200 sieve when tested in accordance with ASTM C 136. The amount of clay lumps or balls not exceeding 2 percent.

2. Material passing the number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318:

   a. Liquid limit not exceeding 25.

   b. Plasticity index not exceeding 7.

E. Concrete Sand: Natural sand, manufactured sand, or a combination of natural and manufactured sand conforming to the requirements of ASTM C 33 and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8”	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

F. Gem Sand: Sand conforming to the requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing

3/8″	95 to 100
No. 4	60 to 80
No. 8	15 to 40

G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
2″	100
3/8″	85 to 100
No. 4	10 to 30
No. 8	0 to 10
N0. 16	0 to 5

H. Crushed Aggregates: All crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. All materials of one product delivered for the same construction activity from a single source.

2. Non-plastic fines.

3. Los Angeles abrasion test wear not exceeding 40 percent when tested in accordance with ASTM C 131.

4. Gradations, as determined in accordance with TEX-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment By Ranges of Nominal Pipes Sizes		
	>15″	15″ – 8″	<8″
1″	95 – 100	100	-

3/4"	60 – 90	90 – 100	100
1/2"	25 – 60	-	90 – 100
3/8"	-	20 – 55	40 – 70
No. 4	0 – 5	0 – 10	0 - 15
No. 8	-	0 – 5	0 - 5

5. Crushed stone: Produced from oversize quarried aggregate, sized by crushing from a naturally occurring single source. Crushed gravel or uncrushed gravel are not acceptable materials for utility embedment.

6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are the same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, base course material, reinforcing steel fragments, soil, debris, or deteriorated concrete fragments.

I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Section 02570 - Pavement Repair and Resurfacing, to meet plasticity criteria.

J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by the applicable backfill installation specification. Refer to Section 02226 - Excavation and Backfill for Structures and Section 02227 - Excavation and Backfill for Utilities.

K. Cement Stabilized Sand: Conform to requirements of Section 02252 - Cement Stabilized Sand.

L. Concrete Backfill: Conform to Class B concrete as specified in Section 03305 - Concrete for Utility Construction or Section 03310 - Concrete for Structures.

M. Pavement Restoration: Conform to requirements of Section 02570 - Pavement Repair and Resurfacing.

PART 3 E X E C U T I O N

3.01 SOURCES

A. Use of material encountered in the trench excavations is acceptable, provided applicable specification requirements are satisfied. If excavation material is not acceptable, provide from other source.

B. Obtain approval for each material source by the Owner's Representative before delivery is started. If sources previously approved do not produce uniform and satisfactory products, furnish materials from other approved sources. All materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet the requirements of the specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once a material is approved by the Owner's Representative, expense for sampling and testing required to change to a different material will be credited to the Owner through a change order.

C. Bank run sand, select backfill, and random backfill, if available in the Project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete the work from off-site sources.

D. The Owner does not represent or guarantee that any soil found in the excavation work will be suitable and acceptable as backfill material.

3.02 MATERIAL HANDLING

A. When backfill material is obtained from either a commercial or non-commercial borrow pit, have that pit opened to expose the vertical faces of the various strata of acceptable material to be used. Excavate the material by vertical cuts extending through the exposed strata to achieve uniformity in the product.

B. Establish temporary stockpile locations for practical material handling and control, and verification testing by the Owner's Representative in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.

C. When stockpiling backfill material near the Project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering the drainage system.

D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.03 MATERIAL QUALITY CONTROL

A. Ensure that material selected, produced and delivered to the Project meets applicable specifications and is of sufficient uniform properties to allow practical construction and quality control. Responsibilities include:

1. Source or Supplier Qualification. Perform testing, or obtain representative tests by suppliers, for selection of material sources and products. Provide test results for a minimum of three samples for each source and material type. Test samples of processed materials from current production representing material to be delivered. Tests shall verify that the materials meet specification requirements. Repeat qualification test procedures each time the source characteristic changes or there is a planned change in source location or supplier. Qualification tests shall include, as applicable:

    a. Gradation. Complete sieve analyses shall be reported regardless of the specified control sieves. The range of sieves shall be from the largest particle through the No. 200 sieve.

    b. Plasticity

    c. Los Angeles abrasion

    d. Clay lumps

    e. Light weight pieces

    f. Organic impurities

2. Production Testing. Establish a program to provide assurance that backfill materials delivered from the sources and placed in the Work meet applicable specification requirements. Report results to the Owner’s Representative.

3. Assist the Owner’s Representative in obtaining material samples for verification testing at the source or at the production plant.

4. Notify the Owner’s Representative in the field when non-conforming material is detected.

B. Quality Control

1. The Owner’s Representative may sample and test backfill at:

    a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.

    b. On-site stockpiles.

c. Materials placed in the Work.

2. The may Owner's Representative resample material at any stage of work or location if changes in characteristics are apparent.

3. The Owner's Representative will notify Contractor at the Project site about non-conforming materials and will, as appropriate, resample materials to verify results.

C. Tolerances

The following tolerances apply to production quality control testing.

1. Embedment Material and Select Backfill: The Owner's Representative may accept material provided that not more than one out of the most recent five consecutive tests is out of the specification limits for:

   a. Gradation: Not more than 5 percentage points on any individual sieve.

   b. Plasticity: Not more than 2 percentage points.

2. Trench Zone Backfill Material: Except for select and random backfill, the Owner's Representative may accept the material provided that not more than one out of the most recent three consecutive tests is out of the specification limits for:

   a. Gradation: Not more than 8 percentage points on any individual sieve.

   b. Plasticity: Not more than 5 percentage points.

3. Select and Random Backfill: No quantified tolerances. Remove non-conforming material identifiable by visual-manual procedure.

END OF SECTION

SECTION 02231

CRUSHED STONE FLEXIBLE BASE COURSE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of crushed stone.

1.02 UNIT PRICES

A. Measurement for crushed stone flexible base is on a square yard basis. Separate measurement will be made for each different required thickness of base course.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all provisions and sections of these specifications.

B. Submit samples of crushed stone and soil binder for testing.

1.04 TESTS

A. Tests and analysis of soil materials will be performed in accordance with ASTM C131, ASTM D1557, ASTM D4318, Tex-101-E, and Tex-110-E under provisions of Section 01410 - Testing Laboratory Services.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stockpiles shall be made up of layers of processed aggregate materials. Load material by making successive vertical cuts through entire depth of stockpile.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Crushed Stone: Material retained on the No. 40 Sieve meeting the following requirements:

1. Durable particles of crusher-run broken limestone, sandstone, or granite obtained from an approved source.

2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C131.

B. Soil Binder: Material passing the No. 40 Sieve meeting the following requirements when tested in accordance with ASTM D4318:

1. Maximum Liquid Limit: 40.

2. Maximum Plasticity Index: 12.

3. Maximum Lineal Shrinkage: 7 (when calculated from volumetric shrinkage at liquid limit).

C. Mixed Materials shall meet the following requirements:

1. Minimum compressive strength of 35 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure using triaxial testing procedures.

2. Grading in accordance with Tex-101-E and Tex-110-E within the following limits:

Sieve	Percent Retained
1-3/4 inch	0 to 10
No. 4	45 to 75
No. 40	60 to 85

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Prepare subgrade in accordance with requirements of Section 02221 and Section 02225 or Sections 02241.

C. Correct subgrade deviations in excess of plus or minus 1/2 inch in cross section, or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

D. Prepare sufficient subgrade in advance of base course operations.

3.03 PLACEMENT

A. Spread and shape in lifts to compacted thickness not to exceed 8 inches. Complete spreading, shaping, and compacting on same day material is deposited.

B. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Secure a firm bond between reinforcement and base.

C. Start rolling operations as soon as possible after placement. Use sheepfoot, steel, or pneumatic rollers as approved. Roll longitudinally with subgrade starting from sides. Overlap successive strips by one-half width of each rear wheel.

D. Maintain moisture between optimum and 3 percent above optimum moisture.

E. Compact to 95 percent of Modified Proctor density in accordance with ASTM D1557, unless otherwise indicated on the Drawings.

F. Finish to grade and compact lift before placing successive lift.

G. Maintain shape by grading throughout operation.

H. Provide total thickness indicated on Drawings.

3.04 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top surface of embankment: Plus or minus 1/4 inch in cross section, or in 16 foot length.

3.05 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one core will be taken at random locations per 1,000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no additional cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 at a random location near each depth determination core. Rework and recompact areas that do not conform to compaction requirements.

E. Fill cores and density test sections with new compacted crushed stone flexible base.

3.06 PROTECTION

A. Sprinkle to prevent excessive loss of moisture.

B. Restrict construction traffic on finished base to equipment required to complete the work.

END OF SECTION

SECTION 02233

CEMENT STABILIZED BASE COURSE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of cement stabilized crushed stone.

B. Foundation course of cement stabilized bank run gravel.

1.02 UNIT PRICES

A. Measurement for Cement Stabilized Base Course is on a square yard basis. Separate measurement will be made for each different required thickness of base course.

B. Measurement for asphaltic seal cure is by the square yard.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit samples of crushed stone, gravel, and soil binder for testing.

C. Submit weight tickets, certified by supplier, with each bulk delivery of cement to work site.

D. Submit manufacturer's description and characteristics for pug mill and associated equipment, spreading machine, and compaction equipment for approval.

1.04 TESTS

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Tests and analysis of aggregate and binder materials will be performed in accordance with ASTM D1557 and ASTM D4318.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Make stockpiles from layers of processed aggregate so as to eliminate segregation of materials. Load material by making successive vertical cuts through entire depth of stockpile.

B. Store cement in weatherproof enclosures. Protect from ground dampness.

PART 2 P R O D U C T S

2.01 CEMENT

A. ASTM C150 Type I; bulk or sacked.

2.02 WATER

A. Water: Clean; clear; and free from oil, acids, alkali, or vegetable matter.

2.03 AGGREGATE

A. Crushed Stone: material retained on the No. 40 Sieve meeting the following requirements:

1. Durable particles of crusher-run broken limestone obtained from an approved source.

2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C131.

B. Gravel: Durable particles of bank run gravel or processed material.

C. Soil Binder: Material passing the No. 40 Sieve meeting the following requirements when tested in accordance with ASTM D4318:

1. Maximum Liquid limit: 35.

2. Maximum Plasticity index: 10.

D. Mixed aggregate and soil binder shall meet the following requirements:

1. Grading in accordance with Tex-101-E and Tex-110-E within the following limits:

Sieve	Percent Retained			
	Crushed Stone	Processed GR. 1	Gravel GR. 2	Bankrun Gravel
1-3/4”	0 to 10	0 to 5	-	0 to 5
1/2"	-	-	0	-
No. 4	45 to 75	30 to 75	15 to 35	30 to 75
No. 40	55 to 80	60 to 85	55 to 85	65 to 85

2. Obtain prior permission from Owner’s Representative for use of additives to meet above requirements.

2.04 ASPHALTIC SEAL CURE

A. Cut back asphalt: MC30 conforming to requirements of Section 02511.

B. Emulsified petroleum resin: EPR-1 Prime conforming to requirements of Section 02511.

2.05 MATERIAL MIX

A. Design mix for minimum average compressive strength of 200 psi at 48 hours using Tex-120-E unconfined compressive strength testing procedures. Provide minimum cement content of 1-1/2 sacks, weighing 94 pounds each sack, per ton of mix.

B. Increase cement content if average compressive strength of tests on field samples fall below 200 psi. Refer to Part 3 concerning field samples and tests.

C. Mix in stationary pug mill equipped with feeding and metering devices which shall add specified quantities of base material, cement, and water into mixer. Dry mix base material and cement sufficiently to prevent cement balls from forming when water is added.

D. Resulting mixture shall be homogeneous and uniform in appearance.

2.06 SOURCE QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Testing for unconfined compressive strength will be performed by Test Method Tex-120-E as follows:

1. Three samples will be molded each day or for each 1,000 tons of production.

2. Compressive strength shall be the average of three tests for each production lot.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Prepare subgrade in accordance with requirements of Section 02221 and Section 02225 or Sections 02241.

C. Correct subgrade deviations in excess of plus or minus 1/2 inch in cross section, or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

D. Prepare sufficient subgrade in advance of base course for efficient operations.

3.03 PLACEMENT

A. Do not mix and place cement stabilized base when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.

B. Place material on prepared subgrade in uniform layers to produce thickness indicated on Drawings. Depth of layers shall not exceed 8 inches. Do not dump material in piles or windrows.

C. Spread with approved spreading machine. Conduct spreading so as to eliminate planes of weakness or pockets of nonuniformly graded material resulting from hauling and dumping operations.

D. Provide construction joints between new material and stabilized base that has been in place 4 hours or longer. Joints shall be approximately vertical. Form joint with a

temporary header or make vertical cut of previous base immediately before placing subsequent base.

E. Use only one longitudinal joint at center line under main lanes and shoulder. Do not use longitudinal joints under frontage roads and ramps.

F. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Secure a firm bond between reinforcement and base.

3.04 COMPACTION

A. Start compaction as soon as possible but not more than 60 minutes from start of moist mixing. Compact loose mixture with approved tamping rollers until entire depth is uniformly compacted. Do not allow stabilized base to mix with underlying material.

B. Correct irregularities or weak spots immediately by replacing material and recompacting.

C. Apply water to maintain moisture between optimum and 3 percent above optimum moisture as determined by ASTM D1557. Mix in with a spiked tooth harrow or equal. Reshape surface and lightly scarify to loosen imprints made by equipment.

D. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.

E. Finish by blading surface to final grade after compacting final course. Seal with approved pneumatic tired rollers which are sufficiently light to prevent surface hair line cracking. Rework and recompact at areas where hairline cracking develops.

F. Compact to minimum density of 95 percent of modified Proctor density at a moisture content of treated material between optimum and 3 percent above optimum as determined by ASTM D1557, unless otherwise indicated on the Drawings.

G. Maintain surface to required lines and grades throughout operation.

3.05 CURING

A. Moist cure for minimum of 7 days before adding pavement courses. Restrict traffic on base to local property access. Keep subgrade surface damp by sprinkling.

B. If indicated on Drawings, cover base surface with a curing membrane as soon as finishing operation is complete. Apply with approved self-propelled pressure distributer at following rates, or as indicated on Drawings:

1. MC30: 0.1 gallon per square yard.

2. EPR-1 Prime: 0.15 gallon per square yard.

C. Do not use cutback asphalt during the period of April 16 to September 15.

3.06 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top surface of base course: Plus or minus 1/4 inch in cross section, or in 16-foot length.

3.07 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one core will be taken at random locations per 1,000 linear feet per lane of roadway or 1000 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 at a random location near each depth determination core. Rework and recompact areas that do not conform to compaction requirements at no additional cost to the Owner.

E. Fill cores and density test sections with new compacted cement stabilized base.

3.08 PROTECTION

A. Maintain stabilized base in good condition until completion of work. Repair defects immediately by replacing base to full depth.

B. Protect the asphalt membrane, if used, from being picked up by traffic. The membrane may remain in place when proposed surface courses or other base courses are to be applied.

END OF SECTION

SECTION 02241

LIME STABILIZED SUBGRADE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of lime stabilized natural subgrade material.

1.02 UNIT PRICES

A. Measurement for Lime Stabilized Subgrade is on a square yard basis. Separate measurement will be made for each different required thickness of stabilized subgrade.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit certificates stating that hydrated lime, quicklime, or commercial lime slurry complies with these specifications.

C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.

D. Submit manufacturer's description and characteristics for rotary speed mixer and compaction equipment for approval.

1.04 TESTS

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.

C. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.

D. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.

E. Soil will be evaluated to establish percent of hydrated lime, quicklime, or lime slurry to be applied to subgrade material.

F. Moisture-density relationship will be established on material sample from roadway, after stabilization with lime, in accordance with ASTM D698.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Bagged lime shall bear manufacturer's name, product identification, and certified weight. Bags varying more than 5 percent of certified weight may be rejected; average weight of 50 random bags in each shipment shall not be less than certified weight.

B. Store lime in weatherproof enclosures. Protect lime from ground dampness.

C. Quicklime can be dangerous; exercise extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

PART 2 P R O D U C T S

2.01 WATER

A. Water shall be clean; clear; and free from oil, acids, alkali, or organic matter.

2.02 LIME

A. Type A - Hydrated lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide and magnesium hydroxide.

B. Type B - Commercial lime slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.

C. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:

1. Grade DS: Pebble quicklime of a gradation suitable for use in the preparation of a slurry for wet placing.

2. Grade S: Finely-graded quicklime for use in the preparation of a slurry for wet placing. Do not use grade S quicklime for dry placing.

D. Lime shall conform to following requirements:

CHEMICAL COMPOSITION	TYPE		
	A	B	C
Active lime content, % by weight $Ca(OH)_2$+CaO	90.0 min[1]	87.0 min[2]	-
Unhydrated lime content, % by weight CaO	5.0 max	-	87.0 min
Free water content, % by weight H_2O:	5.0 max	-	-
SIZING			
Wet Sieve, as % by weight residue retained:			
No. 6	0.2 max	0.2 max[2]	8.0 max[3]
No. 30	4.0 max	4.0 max[2]	-
Dry sieve, as % by weight residue retained:			
1 – inch	-	-	0.0
3/4-inch	-	-	10.0 max

Notes:

1. Maximum 5.0% by weight CaO shall be allowed in determining total active lime content.
2. Maximum solids content of slurry.
3. Total active lime content, as CaO, in material retained on the No. 6 sieve shall not exceed 2.0% by weight of original Type C lime.

E. Lime slurry may be delivered to the job site as commercial lime, or may be prepared at the job site by using hydrated lime or quicklime. The slurry shall be free of liquids

other than water and shall be of a consistency that can be handled and uniformly applied without difficulty.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify subgrade lines and grades are correct.

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Cut material to bottom of subgrade using an approved cutting and pulverizing machine meeting following requirements:

1. Cutters accurately provide a smooth surface over entire width of cut to plane of secondary grade.

2. Visible indication that cut is to proper depth.

C. Alternatively, scarify or excavate to bottom of stabilized subgrade. Remove material or windrow to expose secondary grade. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting. Obtain uniform stability.

D. Proof roll subgrade prior to lime application.

3.03 LIME SLURRY APPLICATION

A. Mix hydrated lime or quicklime with water to form a slurry of the solids content specified. Commercial lime slurry shall have dry solids content as specified. Conform to cautionary requirements of Paragraph 1.05C concerning use of quicklime.

B. Apply slurry with a distributer truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on the same working day.

C. Apply so that dry subgrade will contain a minimum lime content of 5 percent by weight of dry subgrade unless otherwise instructed by Testing Laboratory.

3.04 PRELIMINARY MIXING

A. Do not mix and place material when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.

B. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.

C. Shape mixed subgrade to final lines and grades.

D. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.05C can be met during preliminary mixing:

1. Seal subgrade as a precaution against heavy rainfall by rolling lightly with light pneumatic rollers.

2. Cure soil-lime material for 3 days minimum. Keep subgrade moist during cure.

3.05 FINAL MIXING

A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.

B. Add water to bring moisture content of soil mixture to a minimum of optimum or above.

C. Mix and pulverize until all material passes a 1-3/4-inch sieve; a minimum of 85 percent, excluding nonslacking fractions, passes a 3/4-inch sieve; and a minimum of 60 percent excluding nonslacking fractions passes a No. 4 sieve.

D. Shape mixed subgrade to final lines and grades.

E. Do not expose hydrated lime to open air for 6 hours or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

3.06 COMPACTION

A. Aerate or sprinkle to attain optimum moisture content as determined by Testing Laboratory. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.

B. Start compaction immediately after final mixing, unless approved by Owner's Representative.

C. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches.

D. Compact with approved heavy pneumatic or vibrating rollers, or a combination of tamping rollers and light pneumatic rollers. Begin compaction at the bottom and continue until entire depth is uniformly compacted.

E. Do not allow stabilized base to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.

F. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:

1. Areas to receive pavement without subsequent base course: Minimum density of 98 percent of maximum dry density.

2. Areas to receive subsequent base course: Minimum density of 95 percent of maximum dry density.

G. Seal with approved light pneumatic tired rollers: Prevent surface hair line cracking. Rework and recompact at areas where hairline cracking develops.

3.07 CURING

A. Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. Time may be adjusted as approved by Owner's Representative. Subgrade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

B. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

C. Place base, surface, or seal course within 14 days after final mixing and compaction unless prior approval is obtained from Owner's Representative.

3.08 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16-foot length.

3.09 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one phenolphthalein test will be made at random locations per 1000 linear feet per lane of roadway or 1000 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017 at a random location near depth determination tests. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.

E. Fill test sections with new compacted lime stabilized subgrade.

3.10 PROTECTION

A. Maintain stabilized subgrade to lines and grades and in good condition until placement of base or surface course. Protect the asphalt membrane, if used, from being picked up by traffic.

B. Repair defects immediately by replacing material to full depth.

END OF SECTION

SECTION 02249

GEOTEXTILE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Geotextile fabric, also called filter fabric, in applications such as a pipe embedment wrap, around the exterior of a tunnel liner, or around the foundations of pipeline structures and slope stabilization.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this Section. Include the cost of such work in unit prices for work requiring geotextile, such as pipe embedment, sewer line in tunnel, or placement of manhole foundations, as appropriate.

1.03 SUBMITTALS

A. Submittals shall conform to the requirements of all sections and provisions of these specifications.

B. Submit the standard manufacturer's catalog sheets and other pertinent information, for approval, prior to installation.

C. Submit installation methods, as a part of the work plan for tunneling or for excavation and backfill for utilities. Obtain approval from Owner’s Representative for geotextile material and the proposed installation method prior to use of the geotextile.

PART 2 P R O D U C T S

2.01 GEOTEXTILE

A. Provide a geotextile (filter fabric) designed for use in geotechnical applications which forms a permeable layer or media while retaining the soil matrix.

B. Use a fabric which meets the physical requirements for Class A Subsurface Drainage installation conditions as defined in AASHTO M288 and as specified in paragraph 2.02.

2.02 PROPERTIES

A. Material: Nonwoven, nonbiodegradable, fabric consisting only of continuous chain polymer filaments or yarns, at least 85 percent by weight polyolefins, polyesters or polyamide, formed into a dimensionally stable network.

B. Chemical Resistance: Inert to commonly encountered chemicals and hydrocarbons over a pH range of 3 to 12.

C. Physical Resistance: Resistant to mildew and rot, ultraviolet light exposure, insects and rodents.

D. Minimum Test Values:

Property	Value (Min.)	Test Method
Grab Strength	180 lbs.	ASTM D 4632
Trapezoidal Tear Strength	50 lbs.	ASTM D 4533
Puncture Strength	80 lbs.	ASTM D 4833
Mullen Burst Strength	290 psi.	ASTM D 3786
Apparent Opening Size[(1)]	0.25 mm	ASTM D 4751
Permittivity (sec^{-1})	0.2	ASTM D 4491

[(1)]Maximum average roll value

PART 3 E X E C U T I O N

3.01 LINE WORK

A. Use geotextile with backfill for utilities in conformance with Section 02227 - Excavation and Backfill for Utilities.

3.02 TUNNEL WORK

A. Use geotextile outside of a tunnel primary liner to prevent the migration of soil fines into the excavated tunnel resulting in voids or settlement. Conform to Section 02310 - Tunnel Excavation and Primary Liner. Select a geotextile, subject to the minimum requirements of Paragraph 2.02, meeting tunnel liner design requirements and installation conditions.

END OF SECTION

SECTION 02252

CEMENT STABILIZED SAND

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cement stabilized sand for backfill and bedding.

1.02 UNIT PRICES

A. No payment will be made for cement stabilized sand under this Section unless an extra unit price item is included in the Bid Proposal and the application of the pay item is approved by the Owner's Representative. Include payment for cement stabilized sand in unit price for applicable bid items.

B. If use of cement stabilized sand is allowed based on the Owner's Representative's direction the extra unit price item will be paid on a per ton basis. A conversion between volume calculated based on theoretical limits and total weight will be made based on a ratio of 1.64 tons per cubic yard.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit material qualification and mix design tests to include:

1. Three series of tests of sand or fine aggregate material from the proposed source. Tests shall include procedures defined in Paragraph 2.01.

2. Three moisture-density relationship tests prepared using the material qualified by the tests of Paragraph 1.03B.1. Blends of fine aggregate from crushed concrete and bank run sand shall be tested at the ratio to be used for the mix design testing.

3. Mix design report to meet the design requirements of Paragraph 1.04. The mix design shall include compressive strength tests after 48-hours and 7 days curing.

C. Submit stamped load tickets with time of loading directly after mixing.

1.04 DESIGN REQUIREMENTS

A. Design sand-cement mixture to produce a minimum unconfined compressive strength of 100 pounds per square inch in 48 hours when compacted to 95 percent in accordance with ASTM D558 and when cured in accordance with ASTM D1632, and tested in accordance with ASTM D1633. Mix for general use shall contain a minimum of 1-1/2 sacks of cement per cubic yard. Mix for use as sanitary sewer embedment within 9 feet of waterlines shall contain 2 sacks of cement per cubic yard. Compact mix with a moisture content on the dry side of optimum.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Cement: Type 1 Portland cement conforming to ASTM C150.

B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C33, or requirements for Bank Run Sand of Section 02229 - Utility Backfill Materials, and the following requirements:

1. Classified as SW, SP or SM by the United Soil Classification System of ASTM D2487.

2. Deleterious materials:

a. Clay lumps, ASTM C142; less than 0.5 percent.

b. Lightweight pieces, ASTM C123; less than 5.0 percent.

c. Organic impurities, ASTM C40; color no darker than the standard color.

3. Plasticity index of 4 or less when tested in accordance with ASTM D4318.

C. Fine aggregate manufactured from crushed concrete meeting the quality requirements for crushed rock material of Section 02229 - Utility Backfill Materials, may be used as a complete or partial substitute for bank run sand. The blending ratio of fine aggregate from crushed concrete and bank run sand shall be defined in the mix design report.

D. Water: Potable water, free of oils, acids, alkalis, organic matter or other deleterious substances, meeting requirements of ASTM C94.

2.02 MIXING MATERIALS

A. Thoroughly mix sand, cement and water in proportions of the mix design using a pugmill-type mixer. The plant shall be equipped with automatic weight controls to ensure correct mix proportions.

B. Stamp batch ticket at plant with time of loading directly after mixing. Material not placed and compacted within 4 hours after mixing shall be rejected.

C. No hand mixing is allowed on site.

PART 3 E X E C U T I O N

3.01 PLACING

A. Place sand-cement mixture in 8-inch-thick loose lifts and compact to 95 percent of ASTM D558, unless otherwise specified. The moisture content during compaction shall be on the dry side of optimum but sufficient for hydration. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at the plant.

B. Do not place or compact sand-cement mixture in standing or free water.

3.02 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabilized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 lb each from the first, middle, and last third of the truck and composite them into one sample for test purpose.

C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.

D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.

E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.

F. A strength test will be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.

G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D 1633 Section 9.

H. Reporting: Test reports shall contain, as a minimum, the following information:
1. Supplier and plant number
2. Time material was batched
3. Time material was sampled
4. Test age (exact hours)
5. Average 48-hour strength
6. Average 7-day strength
7. Specification section number
8. Indication of compliance / non-compliance
9. Mixture identification
10. Truck and ticket numbers
11. The time of molding
12. Moisture content at time of molding
13. Required strength
14. Test method designations
15. Compressive strength data as required by ASTM D 1633
16. Supplier mixture identification
17. Specimen diameter and height, in.
18. Specimen cross-sectional area, sq. in.

3.03 ACCEPTANCE

A. Strength level of material will be considered satisfactory if:
1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.

2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.

B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.04 Adjustment for Deficient Strength.

C. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.

D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which

exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.
Testing laboratory shall notify Contractor, Project Manager, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.

E. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03.A.

F. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less that 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.04 ADJUSTMENT FOR DEFICIENT STRENGTH

A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.

B. When mixture produces 7-day compressive strength less than 100 psi and greater than or equal to 70 psi, material shall be accepted contingent on credit in payment. Compute credit by the following formula:

$$\text{Credit per Cubic Yard} = \frac{\$30.00 \times 2\,(100 \text{ psi} - \text{actual psi})}{100}$$

C. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to City.

END OF SECTION

SECTION 02468

AUGER-CAST GROUT PILE FOUNDATIONS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

1.01 This section includes the requirements for the construction of auger-cast grout piles, extending into the earth for foundations and the disposal of excavated material. Drawings show size and type required.

1.02 RELATED WORK

A. Excavation and Backfill for Structures. Section 02226.

B. Concrete Reinforcement. Section 03210.

1.03 UNIT PRICES

A. Base Bid: Contractor shall bid on total lineal footage of production pile indicated for base bid.

B. Base bid will be adjusted in amount (add or deduct) determined by multiplying the difference between base bid length indicated and total length of production pile installed by appropriate unit price on proposal form.

C. Total Length of production piles:

1. Accumulated length of all production piles from top to cut-off.
2. Do not include rejected piles.
3. Include discontinued piles and additional piles due to obstructions.

1.04 DEFINITIONS

A. The pay length of the pile is from the tip to the cut-off elevation shown on the Drawings. No payment will be made for rejected piling unless the Geotechnical Engineer determines that the pile capacity cannot be developed because of an obstruction. No payment will be made for cutting off piling or for any portion of the pile remaining above cut-off elevation except where specifically authorized.

B. Pile: Cast-in-place pile made by rotating a continuous helical flight hollow shaft auger into the subsoil and injecting grout under sufficient pressure as auger is withdrawn to insure a continuous column of grout of minimum diameter(s) and compression and/or tension design capacities indicated

1.05 SUBMITTALS

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

B. Shop Drawings: For steel reinforcement detailing fabricating, bending, supporting, and placing.

C. Design Mixes: For grout. Include revised mix proportions when characteristics of materials project conditions, weather, test results, or other circumstances warrant adjustments.

1. Laboratory Rest Reports: For compressive strength of grout materials.

D. Drilling Records: Upon completion of the auger-cast pile foundation work, submit two copies of the drilling records to the Owner's Representative. Maintain a copy of the drilling records at the construction site. Do not construct cap, grade beam, column, or slab, as applicable, on top of the pile foundation until after the drilling records have been reviewed by the Owner's Representative. See Part 3 for information to be included in drilling records.

E. Existing Utilities: Notify the Owner's Representative when any sewer, water, gas, electric, or other utility lines are encountered during drilling operations. Protect such utility lines from damage. Suspend drilling operations until satisfactory arrangements are made with the proper authorities for removal, relocation, or tapping of the line.

1.06 QUALIIFICATIONS AND EQUIPMENT

A. Excavation under this section must be executed by a foundation driller experienced and equipped to perform auger-cast pile foundation work as required. The Contractor shall have a minimum of 3 years' experience in the installation of auger-cast piles of the diameter, length and installation method similar to the piles required for this project. Use equipment and tools specially designed for drilling and shaping foundations to depth, size and section shown.

1.07 EXISTING CONDITIONS

A. Subsurface Information. Soil borings for design purposes have been made at this site. The location and log of each is shown in the Geotechnical Investigation Report prepared for this project. The depth of the water table at the time the borings were made is shown in the logs. The Contractor is expected to have examined the site and the record of the investigation and to have decided the character of the materials to be encountered.

B. Obstructions. Excavate and remove any shallow obstacles or obstructions encountered which make it impossible to place the piling. Obstructions encountered which are not covered in the Contract Documents will be handled in accordance with the General Conditions

1.08 CHANGES IN DEPTHS OF FOOTINGS

A. It may be necessary to lower or raise the bottom of piles from planned depth shown on the drawings to found on soil of adequate bearing capacity. Changes in the planned depth shall be made only upon approval of the Architect/Engineer. Maintain a record of actual founding depths.

B. If the average authorized depth is between plan average depth plus or minus 12 inches, no adjustment in contract sum will be made.

C. If the average authorized depth exceeds plan average depth by more than 12 inches, or is shallower than plan average depth by more than 12 inches, an adjustment in the contract sum will be made under a change order as provided in the General Conditions of the Contract.

D. Depths will be measured from bottom of pile to the upper termination of the pile cap, grade beam, column or slab, as applicable. Average depths will be computed for each pile size

1.09 ALLOWABLE TOLERANCES

A. Place piling with a maximum tolerance of 2 inches from the designed location for one- and two-pile groups or 4 inches from the designed location for other groupings and a variation from the vertical of not more than two percent of its depth.

1.10 DELIVERY AND STORAGE

A. Schedule material and delivery so that items may be erected promptly after arrival. If materials must be stored at the project site, they shall be stored above ground on platforms, skids or other supports. Material stored at the site shall be kept free of dirt, mud, grease or oil. Protect stored material from corrosion.

PART 2 P R O D U C T S

2.01 GROUT

A. Use a mixture of Portland cement, pozzolanic material, grouting agent, sand and water so proportioned and mixed as to produce a grout capable of maintaining the solids in suspension without appreciable water gain, yet which may be pumped without difficulty and which will penetrate and fill completely any voids in the soils. Proportion materials to produce a hardened intrusion grout with a 28 day compressive strength equal to 4000 psi as determined with 3 inch x 6 inch cylinders. The grout shall have a consistency measured with Corps of Engineers Specification CRD C-79 not less than 21 seconds. The pozzolanic material and grouting agent shall impart certain other properties as listed below.

1. Portland cement. Conform to "Specification for Portland Cement," ASTM C 150 and Type I.

2. Pozzolanic Material. Use a finely powdered siliceous material which possesses the property of combining with lime liberated during the process of hydration of Portland cement.

3. Grouting Agent. Use an admixture as recommended by the installer. The admixture shall impart to the mortar the properties of reducing mixing water requirements, retarding the rate of stiffening and time of setting, decreasing the tendency toward bleeding and segregation, eliminating setting shrinkage, improving the qualities of pumpability and penetrability of small voids and increasing the strength of the grout.

4. Water. Use fresh, clean water free from injurious amounts of sewage, oil, acids, alkali, salts or organic matter.

5. Fine Aggregate. Conform to the requirements of "Specification for Concrete Aggregates," ASTM C 33, except as hereinafter specified.

    a. Use sand consisting of hard, dense, durable uncoated rock particles free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica and other deleterious substances. If washed, do not remove desirable fines. Drain until the residual free moisture is reasonably uniform and stable.

    b. Use well graded sand from fine to coarse with fineness modulus between 1.40 and 3.40. The fineness modulus is defined as the total of the cumulative percentages retained on U. S. Standard sieve numbers 16, 30, 50, and 100, divided by 100.

2.02 REINFORCING STEEL

A. Reinforcing steel shall conform to requirements of Section 03210, Reinforcing Steel.

2.01 MIXES

A. Adjust mix as necessary to limit bleeding of completed pile such that water accumulation on pile surface is less than 2 inches and no significant cement loss occur.

2.02 FABRICATION AND MANUFACTUR

A. Capacity. Provide piling designed for a safe load capacity shown on the Drawings. Criteria listed in this specification and indicated on the Drawings are minimum requirements.

B. Size of Piling. Minimum diameter of piling is shown on Drawings.

C. Mixing and Pumping Grout. Use only approved mixing and pumping equipment in the preparation and handling of intrusion grout. Remove all oil or other rust inhibitors from the mixing drums, stirring mechanisms and other portions of the equipment in contact with the grout before the mixers are used. Measure all materials by volume or weight as they are fed to the mixer. Provide a pump with a stroke counter or other device to accurately measure quantity of grout used for each pile. Calibrate each pump by pumping a measured volume of at least 50 gallons. The time of mixing shall be such as to produce a homogeneous grout of the desired consistency. If there is a lapse in the operation of intrusion, recirculate grout through the pump or through the mixer drum or agitator and pump. Mix not less than one minute after adding the grouting agent. The grout pump shall be a positive displacement piston type pump capable of developing displacing pressures at the pump up to 350 psi. If agitated continuously, the mortar may be held in the mixer or agitator a maximum of 2 hours at temperatures less than or equal to 70° F and for a period not exceeding 1-1/2 hours at temperatures greater than 70°F.

D. Augering Equipment.

1. The hole through which the grout is pumped during the placement of the pile shall be located at the bottom of the auger head below the bar containing the cutting teeth.
2. The auger flighting shall be continuous from the auger head to the top of auger with no gaps or other breaks. The pitch of the auger flighting shall not exceed 9 inches.
3. Augers over 40 feet in length shall contain a middle guide.
4. The piling leads should be prevented from rotating by a stabilizing arm.
5. The auger shall be attached to the drilling mast by means of a three-part line.
6. Auger opening shall be of such diameter as to permit installation of spliced post-tensioning dywidag bar if splicing of such reinforcing is required.

PART 3 E X E C U T I O N

3.01 INSPECTION

A. Acceptance inspection of piling will be made by the Geotechnical Engineer. The Geotechnical Engineer must be present during all pile placing operations. The Contractor shall notify the Geotechnical Engineer and the Architect/Engineer at least seven (7) days prior to starting pile placing operations. The Geotechnical Engineer will keep a record for each pile placed. The records will give the pay length, location, type, calculated safe load and the results of any tests. Cooperate with the Geotechnical Engineer to facilitate the keeping of these records. The Geotechnical Engineer is a representative of the Architect/Engineer and the Contractor shall assume toward him all the obligations and responsibilities that he assumes toward the Owner.

3.02 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

A. Placement. Assist the Geotechnical Engineer in determining the elevation of the bearing formations by withdrawing the auger for inspection. This procedure shall be performed for the first pile in approximately one-half of the pile groups in locations selected by the Geotechnical Engineer. Auger a hole of specified

diameter and depth, then pump the hole full with grout as the auger is withdrawn. Grout shall be pumped through the auger and ejected at the bottom of the auger head. The bottom of the auger is to be kept submerged in the grout during filling operations to prevent formation of voids in the pile. Keep a head of grout of at least 15 feet above the auger tip at all times while raising the auger. Raise the auger smoothly and at a uniform rate. Coordinate rate of auger removal and the rate of grout injection to maintain sufficient positive pressure in the grout at all times to prevent intrusion of water and soil. While the grout is still fluid, place the steel reinforcement as shown on the Drawings. Attach spacers to the reinforcement to maintain required spacing from the soil. The auger shall not be withdrawn from the bearing formation for any reason without grout being pumped or soil being introduced into the shaft as the auger is being withdrawn to fill up the void left behind.

B. The use of water to facilitate the drilling operation is not acceptable. The use of air may be used to facilitate the drilling operation if approved by the Geotechnical Engineer.

C. Placement of piles adjacent to existing Structures. When pilings are placed adjacent to existing structures, additional precautions shall be taken to guard against movement or settlement of the existing structures. The contractor shall monitor the elevation of the structure before installation of any piling and after the installation of each subsequent pile until all of the piles have been installed. A record of each pile installed and the corresponding elevation at six locations along length of the existing structure shall be kept by the contractor and submitted to the Architect for review before installation of additional piling. No more than one pile shall be installed in each group adjacent to the existing structure on any given day. The Geotechnical Engineer and Architect shall be present during the installation of the piles adjacent to the existing structure.

D. The Contractor alone shall be responsible for the safety and support of the existing structure. The Contractor shall be liable for any movement or settlement, any damage or injury caused by thereby or resulting therefrom. If the safety of the existing structure appears to be endangered, cease operation and take precautions to support the existing structure. Do not resume piling installation until the unsafe condition is corrected. If the Contractor fails to correct the unsafe conditions, corrective action may be taken by the Owner at the Contractor's expense.

E. Should any obstruction, including but not limited to boulders, cobbles, rubble fill, or timbers, be encountered which prevent placing pile to depth required, or cause pile to drift from required location, remove obstruction where possible.

1. When it is impossible or impracticable to remove obstruction and when so directed by the Geotechnical Engineer, complete short pile.
2. Install additional adjacent piles as directed by the Architect.
3. Pile refusal shall be defined as not advancement in drilling for 1 minute or other indications that the auger has encountered an obstruction.

F. Pile Reinforcing

1. Place reinforcing with spacers to prevent contact with soil.
2. Extend bars full length of uplift piling as indicated on the Drawings.

G. Screen the tops of completed piles to remove any soil from the grout. Remove fresh grout to the cutoff elevations or allow the grout to harden overnight and remove hardened grout to the cut off elevation. Do not remove fresh grout below the water table elevation.

3.03 PILE CUT-OFF

A. Cutoff piles at elevations indicated on the Drawings.

1. Remove fresh concrete from top of pile no later than 1 hour after pile installation or at any time after initial set has occurred.
2. Top of piles after cutoff shall be level and with full diameter cross-section.

B. Clean and straighten exposed reinforcement.

3.04 REJECTION OF PILES

A. Piles may be rejected for:

1. Location outside tolerance.
2. Being broken or collapsed.
3. Inadequate grout strength or capacity.
4. Failure to meet specifications.
5. Head less than 15 feet during grouting.
6. Withdrawal of auger from a pile without grouting.

B. Replace rejected piles by lengthening remaining piles in a group or by installing additional piles as directed by the Architect/Engineer.

C. The Contractor is responsible for the cost of increasing the penetration of piles or additional piles required by the Architect to replace rejected piles.

3.05 FIELD QUALITY CONTROL

A. Test grout in conformance with "Test Method for Compressive Strength of Hydraulic Cement Mortars," ASTM C39.

1. Take three (3), 3- inch diameter x 6 inch high test cylinders each morning and afternoon for each drilling operation.
2. Record piles represented by each batch of test cylinders.
3. Cylinder molds: Type which will retain mortar expansion yet permit escape of water and air.
4. Test one cylinder at 7 days and two cylinders at 28 days.

B. Prepare test and inspection reports for each drilled pier as follows:

1. Pile identification mark and location.
2. Actual top and bottom elevations.
3. Actual drilled-pier diameter at top and bottom.
4. Bearing strata description.
5. Final top centerline location and deviations from requirements.
6. Shaft excavating method.
7. Design and tested bearing capacity of bottom.
8. Ground-water conditions and water-infiltration rate and depth.
9. Description, purpose, length, wall thickness, diameter, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
10. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
11. Date and time of starting and completing excavation.
12. Concrete volume.
13. Concrete testing results.
14. Remarks, unusual conditions encountered, and deviations from requirements.

3.06 DISPOSAL OF EXCAVATED MATERIAL

A. Dispose of excavated material not used as backfill around foundations at designated locations on the job site. Deposit in uniform layers and grade to uniform slopes.

END OF SECTION

SECTION 02510

ASPHALTIC CONCRETE PAVEMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Surface courses of compacted mixture of coarse and fine aggregates and asphaltic material.

1.02 UNIT PRICES

A. Measurement for asphaltic concrete pavement is on square yard basis. Separate measurement will be made for each different required thickness of pavement.

B. Payment for asphaltic concrete pavement includes payment for associated work performed in accordance with Section 02512 Tack Coat.

C. Payment for pavement repair or pavement replacement for utility projects is on a square yard basis and includes surface and base materials in accordance with Section 02571 - Pavement Repair for Utilities.

D. Payment for temporary detour pavement or temporary roadway and shoulder is on a square yard basis and includes surface and base materials, associated grading, maintenance and removal as well as restoration of ditches.

E. Payment for speed bumps and speed humps is on linear foot basis, and includes milling of existing pavement, tack coat, and placement and compaction of asphalt.

F. Refer to paragraph 3.08 for unit price adjustments.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit certificates that asphaltic materials and aggregates meet requirements of Article 2.01, Materials, of this Specification Section.

C. Submit proposed design mix and test data for each type and strength of surface course in Work.

D. Submit manufacturer's description and characteristics of mixing plant for approval.

E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

F. Submit batch plant tickets for each truck load delivery of hot mix asphalt. Tickets should be delivered to Owner's Representative.

G. Submit the equipment specifications and details for the instrumentation and equipment for measuring the as-built transverse profile perpendicular to the centerline of the roadway asphalt finished surface from right bottom of curb (BC) to left BC at 25 feet intervals along the right of way. For example, a road laid for 100 feet will have five (5) transverse profiles. Longitudinal profiles shall be collected in the centerline of each lane which includes the parking lane. All longitudinal and transverse profiles of the finished asphalt shall be submitted for review.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Coarse Aggregate: Gravel or crushed stone, or combination thereof, that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic or other injurious matter occurring either free or as coating on aggregate. Aggregate shall conform to ASTM C33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C131. Aggregate by weight shall not contain more than 1.0 percent by weight of fine dust, clay- like particles, or silt when tested in accordance with Tex-217-F, Part II.

B. Fine Aggregate: Sand or stone screenings or combination of both passing No. 10 sieve. Aggregate shall conform to ASTM C33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by Tex-106-E. Sand equivalent shall have a minimum value of 45 when tested by Tex-203-F.

C. Composite Aggregate: Conform to the grading limits of TxDOT Item 340 for the paving type indicated on the drawings.

D. Asphaltic Material: Moisture-free homogeneous material which will not foam when heated to 347 degrees F, meeting following requirements:

VISCOSITY GRADE

Test	AC-10		AC-20	
	Min.	Max.	Min.	Max.
Viscosity, 140E strokes	1000	±200	2000	±400
Viscosity, 275E strokes	1.9	-	2.5	-
Penetration, 77E, 100 g, 5 sec.	85	-	55	-
Flash Point, C.O.C., F.	450	-	450	-
Solubility in trichloroethkene	99.0	-	99.0	-
Tests on residues from thin film oven tests:				
Viscosity, 140E strokes	-	3000	-	6000
Ductility, 77E, 5 cms per min., cms	70	-	50	-
Spot tests	Negative for all grades			

1. Material shall not be cracked

2. The Owner Representative will designate grade of asphalt to use after design tests have been made. Use only one grade of asphalt after grade is determined by test design for project.

2.02 EQUIPMENT

A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuously mixtures meeting specifications. Plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors. Provide equipment to supply materials adequately in accordance with rated

capacity of plant and produce finished material within specified tolerances. Following equipment is essential:

1. Cold aggregate bins and proportioning device.
2. Dryer.
3. Screens.
4. Aggregate weight box and batching scales.
5. Mixer.
6. Asphalt storage and heating devices.
7. Asphalt measuring devices.
8. Truck scales.

B. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix.

2.03 MIXES

A. Employ and pay certified testing laboratory to prepare design mixes. Test in accordance with Tex-126-E or Tex-204-F and Tex-208-F.

B. Density and Stability Requirements:

Percent Density		Percent	HVEEM Stability Percent
Min.	Max.	Optimum	Not Less Than
95	99	97	35

C. Proportions for Asphaltic Material: As specified in TxDOT Item 340 for the paving type shown on the Drawings.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted base course is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Prime Coat: If indicated on the Drawings, apply a prime coat conforming to requirements of Section 02511. Do not apply a tack coat until primed base has cured to satisfaction of the Owner's Representative.

B. Tack Coat: Conform to requirements of Section 02512.

C. Prepare subgrade in accordance with requirements of Section 02238 - Hot Mix Asphalt Base Course, Section 02244 - Cement Stabilized Base Course, or Section 02234 - Recycled Crushed Concrete Base Course.

D. Prepare subgrade in advance of asphalt concrete paving operation.

E. Perform pavement repair and resurfacing as indicated in Section 02951 - Pavement Repair and Restoration.

F. Milling of pavement for speed bumps and speed humps: Mill pavement (concrete or asphalt) to depth of one inch around entire perimeter of speed bump and speed hump.

3.03 PLACEMENT

A. Place asphaltic mixture when the roadway surface temperature is 60 degrees F or higher. Measure the roadway surface temperature with a handheld infrared thermometer. Unless otherwise shown on the plans, place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Owner Representative.

B. Haul prepared and heated asphaltic concrete mixture to the project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.

C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type.

D. Surface Course Material: Surface course 2 inches or less in thickness may be spread in one lift. Spread all lifts in such manner that, when compacted, finished course will be smooth, of uniform density, and will be to section, line and grade as shown. Coincide construction joints on surface courses with lane lines, or as directed by the Owner's Representative.

E. Place courses as nearly continuously as possible. Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back

laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.

F. When new asphalt is laid against existing or old asphalt, existing or old asphalt shall be saw cut full depth to provide straight smooth joint.

G. In restricted areas where use of paver is impractical, spread and finish asphalt by mechanical compactor. Use wood or steel forms, rigidly supported to assure correct grade and cross section. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove any lumps that do not break down readily. Place asphalt courses in same sequence as if placed by machine.

3.04 COMPACTION

A. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hairline cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water.

B. Compress surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing from 8 to 10 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and all rolling

marks are eliminated. Complete all rolling before mixture temperature drops below 175 degrees F.

C. Use tandem roller for final rolling. Double coverage with approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.

D. Along walls, curbs, headers and similar structures, and in all locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.

E. Compact binder course and surface course to density not less than 93 percent of the maximum possible density of voidless mixture composed of same materials in like proportions.

3.05 TOLERANCES

A. Furnish templates for checking surface in finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.

B. Completed surface, when tested with 10-foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct any surface not meeting this requirement.

C. Completed surface, when tested with pavement profiler shall show no deviation in excess of 1/8 inch in 10 feet per submittals 1.03G.

3.06 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Minimum of one core will be taken at random locations per 1,000 feet per lane of roadway or 1,000 square yards of asphalt concrete pavement to determine in-place depth and density.

C. In-place density will be determined in accordance with Tex-207-F and Tex-227-F from cores or sections of asphaltic base located near each core. Other methods of

determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by the Owner's Representative.

D. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

E. Fill cores and density test sections with new compacted asphaltic concrete pavement.

F. Measure pavement profile with a Walking Profiler G3 (Attached) or City Engineer Approved Equivalent in accordance with ASTM E2133-03 Standard Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles on a Travelled Surface. Profile will be evaluated by City and non-conforming pavement will be rejected and shall be repaired until it complies with the acceptable profile as determined by the City. Completed surface, when tested with pavement profiler shall show no deviation in excess of 1/8 inch in 10 feet per submittals 1.03G. Correct any surface not meeting this requirement, even if it means milling and relaying the asphalt to avoid repair patches.

3.07 NONCONFORMING PAVEMENT

A. Recompact pavement sections not meeting specified densities or replace them with new asphaltic concrete material. Replace with new material sections of surface course pavement not meeting surface test requirements or having unacceptable surface texture.

Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute.

B. Remove and replace areas of asphaltic concrete pavement found deficient in thickness by more than 10 percent. Use new asphaltic concrete pavement of thickness shown on Drawings.

C. Nonconforming pavement sections shall be replaced at no cost to Owner.

3.08 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to lower limit of 90 percent and upper limit of 100 percent of unit price bid.

3. Average depth below 90 percent may be rejected by the Owner's Representative.

3.09 PROTECTION

A. Do not open pavement to traffic until 12 hours after completion of rolling, or as shown on Drawings.

B. Maintain asphaltic concrete pavement in good condition until completion of Work.

C. Repair defects immediately by replacing asphaltic concrete pavement to full depth.

3.10 REFERENCES

A. ASTM C 33 - Standard Specification for Concrete Aggregates.

B. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C. TxDOT Tex-106-E - Calculating the Plasticity Index of Soils

D. TxDOT Tex-126-E - Molding, Testing, and Evaluating Bituminous Black Base Material.

E. TxDOT Tex-200-F - Sieve Analysis of Fine and Course Aggregates.

F. TxDOT Tex-203-F - Sand Equivalent Test.

G. TxDOT Tex-204-F - Design of Bituminous Mixtures.

H. TxDOT Tex 206-F - Compacting Test Specimens of Bituminous Mixtures.

I. TxDOT Tex-207-F - Determining Density of Compacted Bituminous Mixtures.

J. TxDOT Tex-208-F - Test for Stabilometer Value of Bituminous Mixtures.

K. TxDOT Tex-217-F - Determining Deleterious Material and Decantation Test for Coarse Aggregates.

L. TxDOT Tex-227-F - Theoretical Maximum Specific Gravity of Bituminous Mixtures.

M. TxDOT Tex-530-C - Effect of Water on Bituminous Paving Mixtures.TxDOT Tex-531-C - Prediction of Moisture Induced Damage to Bituminous Paving Materials Using Molded Specimens.

END OF SECTION



Walking Profiler G3

The Walking Profiler G3 is a high-precision measurement instrument for collecting surface condition information, at true walking speed.

The ARRB Walking Profiler (WP) G3 produces outputs from pavement profile, providing International Roughness Index (IRI), MPD texture (as an optional parameter) and distance.

Differing from previous generations, the WP unit utilises a tri-axial accelerometer mounted on a rolling platform, to enable measurement of longitudinal profile. This platform is separate to the carriage, which means it is less susceptible to operator input.

Data can be collected at variable speeds up to 5km/hr and is controlled by an Android tablet. Real-time results are displayed on the screen, allowing for on-site decision making. Data can then be uploaded to the cloud via a Wi-Fi connection or downloaded via USB cable.

Applications

- Provides outputs of IRI, longitudinal profile and distance
- Reference tool for calibrating and assessing high speed profilers
- Suitable for many surfaces, including:
  - paved roads and footpaths
  - airfields and runways
  - building slabs
  - bridges
  - carparks

precision profiling tool for manual applications

Features

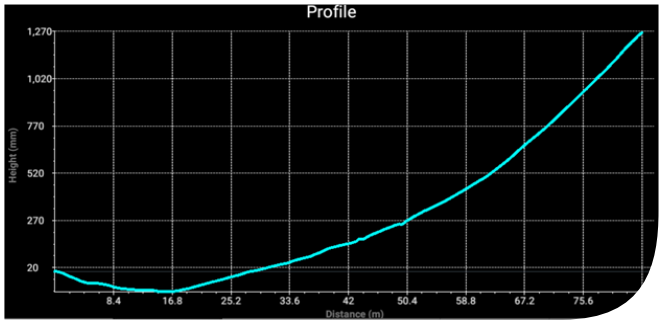
- World Bank Class 1 Profilometry device
- Varying collection speed options
- Option for MPD texture measurement
- Android tablet operation
- Bluetooth connectivity
- Outputs of ERD and PPF files, for use in ProVAL



Components

- Walking Profiler G3 unit
- Android tablet
- Battery charger
- Calibration plate and block
- Transportation case





bsi. ISO 9001 Quality Management

About ARRB

ARRB Group Ltd (ARRB) provides research, consulting and information services to the road and transport industry. ARRB applies research outcomes to develop equipment that collects road and traffic information and software that assists with decision making across road networks. ARRB is the leading provider of road research and best practice workshops in Australia. ARRB Group Ltd | ABN 68 004 620 651

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Walking Profiler G3 Datasheet

Condition	Specification
Compliance	ASTM E2133-03 *Standard Test Method for Using a Rolling inclinometer to Measure Longitudinal and Transverse Profiles on a Travelled Surface*
Speed of Operation	0 to 5km/h
Operation modes	Reference measurements: up to 1 km/h (repeatability >99%, accuracy > 98%)* General measurements: up to 3 km/h (repeatability >99%, accuracy >97%)* Quick measurements: 4-5 km/h (repeatability >97%, accuracy >94%)* Usage modes selectable from interface to aid decision of speed. Audible feedback given to user to aid in operation.
Transducers	1 tri-axial accelerometer, 1 wheel encoder, 1 temperature sensor, 1 laser (optional for texture measurement)
Units	Metric or Imperial
Data sample rate	> 2 kHz
Profile measurement interval (length)	25 mm
Wheel spacing	250 mm
Distance Accuracy	Typical error <0.045% (texture and ΔTemp dependant)
Weight	21.2 kg device only, 22.1 kg in use, 42.0 kg as shipped in case
Profilometry class	ASTM E950 Class 1, World Bank Class 1
Output Parameters	International Roughness Index (IRI), Mean Profile Depth (MPD)
Data Format	PPF, ERD, RAW (proprietary binary), CSV
IRI Accuracy	< 0.03 m/km (< ± 2 inches/mile) on high quality pavements
Wavelength measuring limits	Covers full range of roughness wavelengths up to several hundred metres
Warm up time	None (10 minutes with laser)
Battery Life	20+ hours
Operating temperature	5 - 45°C (41 - 113°F)
Data storage	10Gb on tablet, equivalent to more than 1,700km of profile data
Data transfer	Bluetooth connectivity between unit and tablet (no cables), upload to Cloud data storage via Wi-Fi
Components	Walking Profiler G3 Unit Samsung Galaxy Tab S8.4 Battery Charger Calibration equipment

*When compared to Rod and Level

SECTION 02511

PRIME COAT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Prime coat for asphaltic concrete paving

1.02 UNIT PRICES

A. No separate payment will be made for prime coat under this Section. Include payment in unit price for asphaltic concrete pavement.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit product data for proposed prime coat.

C. Submit report of recent calibration of distributor.

PART 2 P R O D U C T S

2.01 CUTBACK ASPHALT

A. Provide moisture-free homogeneous material which will not foam when heated to 347° F and which meets following requirements:

1. Asphalt material for prime coat shall be MC-30 or MC-70 and shall meet following requirements:

Type-Grade	MC-30		MC-70	
Properties	Min.	Max.	Min.	Max.
Water, percent	0.2	---	0.2	---
Flash Point, T.O.C., °F	100	---	100	---
Kinematic Viscosity at 140°F, cst	30	60	70	140

2. Distillate shall be as follows, expressed as percent by volume of total distillate to 680° F:

	MC-30		MC-70	
	Min.	Max.	Min.	Max.
to 437°F	---	25	---	20
to 500°F	40	70	20	60
to 600°F	75	93	65	90
Residue from 680°F Distillation, Volume, percent	50	---	55	---

3. Tests on Distillation Residue:

	MC-30		MC-70	
	Min.	Max.	Min.	Max.
Penetration at 77°F, 100g, 5 sec.	120	250	120	250
Ductility at 77°F, 5 cm/min. cms	100*	---	100*	---
Solubility in trichloroethylene, %	99	---	99	---
Spot Test	All Negative			

* If penetration of residue is more than 200 and ductility at 77°F is less than 100 cm, material will be acceptable if its ductility at 60°F is more than 100.

2.02 EMULSIFIED PETROLEUM RESIN

A. EPR-1 Prime: Slow curing emulsion of petroleum resin and asphalt cement conforming to the following requirements:

PROPERTIES	MIN	MAX
Fural Viscosity at 77°F, sec	14	40
Residue by Evaporation, % by weight	60	-
Sieve Test, %	-	0.1
Particle Charge Test	Positive	
Tests on the Distillation Residue:		
Flash Point, COC (F)	400	-
Kinematic Viscosity @ 140°F (cSt)	190	350

B. For use, EPR-1 may be diluted with water up to a maximum of three parts water to one part EPR-1 in order to achieve the desired concentration of residual resin/asphalt and facilitate application.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify base is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Thoroughly clean base course surface of loose material by brooming prior to application of tack coat.

B. Prepare sufficient base in advance of paving for efficient operations.

3.03 APPLICATION, GENERAL

A. Apply prime coat with approved type of self-propelled pressure distributor. Distribute prime coat evenly and smoothly under pressure necessary for proper distribution.

B. Keep all storage tanks, piping, retorts, booster tanks and distributors used in handling asphaltic materials clean and in good operating conditions. Conduct operations so that asphaltic material does not become contaminated.

C. If yield of asphaltic material appears to be in error, recalibrate distributor prior to continuing Work.

D. Maintain the surface until Work is accepted by Owner.

3.04 APPLICATION, CUTBACK ASPHALT

A. Do not use cutback asphalt during the period of April 16 to September 15 unless approved by Owner Representative.

B. Apply the mixture when the air temperature is 60 degrees F and above, or above 50 degrees F and rising. Measure the air temperature I the shade away from artificial heat. The Owner Representative will determine when weather conditions are suitable for application.

C. Distribute at rate of 0.25 to 0.35 gallons per square yard.

D. Provide all necessary facilities for determining temperature of asphaltic material in all heating equipment and in distributor, for determining rate of application, and for obtaining uniformity at junction of two distributor loads. Provide and maintain in good working order, recording thermometer at storage heating unit at all times.

E. Temperature of application shall be based on temperature-viscosity relationship that will permit application of asphalt with viscosity of 100 to 125 centistokes. Maintain asphalt within 15° F of temperature required to meet viscosity. Selected temperature shall be within following range.

Prime Coat Type	Minimum (° F)	Maximum (° F)
MC-30	70	150
MC-70	125	175

F. Do not allow temperature of MC-30 to exceed 175° F at any time.

G. Do not allow temperature of MC-70 to exceed 200° F at any time.

3.05 APPLICATION, EMULSIFIED PETROLEUM RESIN

A. Do not place prime coat when air temperature is below 36° F and falling.

B. Distribute at rate of 0.15 to 0.25 gallons per square yard.

3.06 PROTECTION

A. No traffic or placing of subsequent courses shall be permitted over freshly applied prime coat until authorized by the Owner's Representative.

END OF SECTION

SECTION 02521

CONCRETE PAVING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Portland Cement Concrete Paving.

1.02 UNIT PRICES

A. Measurement for concrete paving is on square yard basis. Separate measurement will be made for each different required thickness of pavement.

B. Refer to Paragraph 3.15 for unit price adjustments.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual compressive strength obtained from design mixes at required test ages.

C. Submit manufacturer's description and characteristics for mixing equipment, and for traveling form paver, if proposed for use, for approval.

D. Submit manufacturer's certificates giving properties of reinforcing steel. Provide specimens for testing when required by the Owner’s Representative.

1.04 HANDLING AND STORAGE

A. Do not mix different classes of aggregate without written permission of the Owner’s Representative.

B. Class of aggregate being used may be changed before or during Work with written permission of the Owner’s Representative. New class shall comply with specifications.

C. Segregated aggregate will be rejected. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.

D. Aggregates mixed with dirt, weeds or foreign matter will be rejected.

E. Do not dump or store aggregate in roadbed.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Portland Cement:

1. Sample and test cement to verify compliance with Standards of ASTM C150, Type I or Type III.

2. Bulk cement which meets referenced standards may be used if the method of handling is approved by the Owner's Representative. When using bulk cement, provide satisfactory weighing devices.

3. Fly ash which meets standards of ASTM C618 may be used as mineral fill if the method of handling is approved by the Owner's Representative.

B. Water: Fresh, clear and apparently clean conforming to requirements for water in ASTM C94.

C. Coarse Aggregate: Crushed stone or gravel, or combination thereof, which is clean, hard, and durable, conforms to requirements of ASTM C33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C131).

1. Maximum percentage by weight of deleterious substances shall not exceed following values:

Item	Percent by Weight of Total Sample Maximum
Clay lumps and friable particles	3.0
Material finer then 75-µm (No. 200) sieve:	
Concrete subject to abrasion	3.0*
All Other concrete	5.0*
Coal and lignite:	
Where surface appearance pf concrete is of importance	0.5
All other concrete	1.0

* In case of manufactured sand, if material is finer than 75-µm (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

2. Coarse aggregate (size 1-1/2 inch to No. 4 sieve) shall conform to requirements of ASTM C33. Gradation shall be within following limits when graded in accordance with ASTM C136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 1-3/4" sieve	0
Retained on 1-1/2" sieve	0 to 5
Retained on 3/4" sieve	30 to 65
Retained on 3/8" sieve	70 to 90
Retained on No. 4 sieve	95 to 100
Loss by Decantation Test	
*Method Tex-406-A	1.0 maximum

* In case of aggregates made primarily from crushing of stone, if material finer than the 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of Tex-406-A, percent may be increased to 1.5.

D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Fine aggregate for concrete shall conform to requirements of ASTM C33. Gradation shall be within following limits when graded in accordance with ASTM C136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 3/8" sieve	0
Retained on No. 4 sieve	0 to 5
Retained on No. 8 sieve	0 to 20
Retained on No. 16 sieve	15 to 50
Retained on No. 30 sieve	35 to 75
Retained on No. 50 sieve	65 to 90
Retained on No. 100 sieve	90 to 100
Retained on No. 200 sieve	97 to 100

1. When subjected to color test for organic impurities (ASTM C40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.

E. Mineral Filler: Class C fly ash of acceptable quality and meeting requirements of ASTM C618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, it shall be stored and inspected in accordance with ASTM C618. Fly ash shall not be used in amounts to exceed 30 percent by absolute volume of cementitious material in mix design. Cement content may be reduced if strength requirements can be met. Note: When fly ash is used, the term "cement" is defined as cement plus fly ash.

F. Air Entraining Agent: Furnish an air entraining agent conforming to requirements of ASTM C260.

G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C494 may be used if required to improve the workability of concrete. Amount and type of such admixture shall be subject to approval by the Owner's Representative.

H. Reinforcing Steel:

1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil or other injurious materials.

2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.

I. Fibrous Reinforcing: Conform to requirements of Section 03240. Not to be used in lieu of steel reinforcing.

2.02 EQUIPMENT

A. Equipment: Conform to requirements of ASTM C94.

2.03 MIXING

A. Employ and pay certified testing laboratory to prepare mix designs. Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C31 and tested in accordance with ASTM C39. Contractor shall determine and measure batch quantity of each ingredient, including all water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.

B. Mix design to produce concrete which will have compressive strength of 3000 psi at 7 days and 3500 psi at 28 days. When high-early-strength cement is used, it shall reach at least 3250 psi at 72 hours and 3500 psi at 28 days. Slump of concrete shall be at least 1 inch, but no more than 5 inches, when tested in accordance with ASTM C143.

1. Concrete pavement shall contain at least 5-1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water cement ratio maximum 0.57). Cement content shall be determined in accordance with ASTM C138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.

2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.

3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4-1/2 percent plus or minus 1-1/2 percent. Air content shall be determined by testing in accordance with ASTM C231.

4. Use retardant when temperature exceeds 90 degrees F. Proportion shall be as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted base is ready to support imposed loads and meets compaction requirements.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.

B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

3.03 EQUIPMENT

A. Alternate equipment and methods, other than those required by this article, may be used provided the Contractor demonstrates that equal, or better, results will be obtained and if approved by the Owner's Representative. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.

B. Subgrade Planer and Template:

1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form at all times, and have such strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.

2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have such strength and rigidity that, when

supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1-foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.

C. Machine Finisher: Provide a power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires if it operates on concrete pavement.

D. Hand Finishing (Only to be used when approved by the Owner):

1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.

2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.

E. Belt Finishing: While concrete is still workable, give surface final belting to produce a uniform surface of gritty texture. Perform belting with short rapid transverse strokes having sweeping longitudinal motion.

F. Vibrators: Furnish mechanically operated synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.

G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship shall be met. If traveling form paver does not provide concrete paving that meets the compaction, finish and tolerances requirements of this specification, its use shall be immediately discontinued when so ordered by the Owner's Representative and conventional methods shall be used.

1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Float shall be long enough to extend across pavement to side forms or edge of slab.

2. Insure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations

inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.

3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace any pavement in which tie bars assume final position other than that shown on Drawings, unless corrective alternates are authorized in writing by the Owner's Representative.

3.04 FORMS

A. Side Forms: Use metal or wood forms of approved shape and section. Preferred depth of form shall be equal to required edge thickness of pavement. Forms with depths greater or less than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness is not greater than 1 inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to bottom of form, or by grouting under form. Aluminum forms are not allowed. All forms shall be approved by the Owner's Representative. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide reasonable straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used.

B. Form Setting:

1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by the Owner's Representative.

2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. These adjacent slabs shall not be used for forms until concrete has aged at least 7 days.

3.05 REINFORCING STEEL AND JOINT ASSEMBLIES

A. Accurately place reinforcing steel and joint assemblies and position them securely as indicated on Drawings. Tie reinforcing bars with wire securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Place all reinforcing steel and secure to chairs.

B. Place pavement joint assemblies at required locations and elevations, and rigidly secure all parts in required positions. Install dowel bars accurately in joint assemblies as shown, each parallel to pavement surface and to center line of pavement. Rigidly secure in required position to prevent displacement during placing and finishing of concrete. Accurately cut header boards, joint filler and other material used for forming joints to receive each dowel bar. Drill dowels into existing pavement, secure with epoxy, and provide paving headers, as required, to provide rigid pavement sections.

3.06 FIBROUS REINFORCING

A. Do not use fibrous reinforcing to replace structural, load bearing or moment reinforcing steel.

B. Mix and place in accordance with requirements of Section 03240 (Only when specified).

3.07 PLACEMENT

A. Place concrete only when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Concrete shall not be placed when temperature is below 40 degrees F and falling.

When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.

B. Place concrete within 90 minutes of mixing if concrete temperature is 85 degrees or less. Remove and dispose of concrete not placed within this period.

C. Concrete slump during placement shall be 1 to 5 inches, except when using traveling-form paver slump shall be maximum of 2 inches.

D. Deposit concrete rapidly and continuously on subgrade or subbase in successive batches. Distribute concrete to required depth and for entire width of placement in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At end of day or in case of unavoidable interruption of more than 30 minutes, place transverse construction joint at point of stopping work. Remove and replace sections less than 10 feet long.

E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

3.08 COMPACTION

A. Consolidate the concrete using mechanical vibrators as specified herein. Extend a vibratory unit across the pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.

B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

3.09 FINISHING

A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods (Hand finishing allowed only if approved by the Owner).

1. Use transverse finishing machine to make at least two trips over each area. Make last trip continuous run of not less than 40 feet. After transverse screeding, use hand-operated longitudinal float to test and level surface to required grade.

2. Hand finish with mechanical strike and tamping template as wide as pavement to be finished. Shape template to pavement section. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make at least two trips over each area. Screed pavement surface to required section. Work screed with combined transverse

and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.

C. While concrete is still workable, give surface final belting to produce a uniform surface of gritty texture and striations of 1/16" to 1/8"deep.

3.10 JOINTS AND JOINT SEALING

A. Conform to requirements of Section 02523.

3.11 CONCRETE CURING

A. Conform to requirements of Section 02525.

3.12 TOLERANCES

A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10-foot straightedge parallel to center of roadway to bridge any depressions and touch all high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10-foot straightedge shall not exceed 1/8 inch. Grind spots in excess of requirements of this paragraph to meet surface test requirements, only if approved by the Owner and Owner's representative. Restore texture by grooving concrete to meet surface finishing specifications.

3.13 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made for each 150 cubic yards or less of pavement that is placed in one day. Two specimens will be tested at 7 days or at number of hours as directed by the Project Manager for high early strength concrete. Test the remaining two specimens at 28 days. Specimens will be made, cured and tested in accordance with ASTM C-39. Minimum compressive strength shall be 3000 pounds per square inch at 7 days and 3500 pounds per square inch at 28 days.

C. Yield test will be made in accordance with ASTM C138 for cement content per cubic yard of concrete. If such cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.

D. Minimum of one 4-inch diameter core will be taken at random locations per 1,000 feet per lane or 1000 square yards of pavement to measure in-place depth. Each core may be tested for 28-day compressive strength according to methods of ASTM C42. The 28-day compressive strength of each core tested shall be a minimum of 3500 pounds per square inch.

E. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

F. Fill cores and density test sections with new concrete paving or non-shrink grout.

3.14 NONCONFORMING PAVEMENT

A. Remove and replace areas of pavement found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with concrete of thickness shown on Drawings unless accepted by the Owner's Representative.

B. Remove and replace pavement with unsatisfactory finish as determined by the Owner and Owner's Representative An unsatisfactory finish includes, but is not limited to, rain event that occurs during or after a concrete pour resulting in a poor finish, poor tooling, finishing or sections shall be replaced at no cost to Owner.

3.15 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to a lower limit of 90 percent of unit price bid.

3. No adjustment will be made for excess thickness.

3.16 PAVEMENT MARKINGS

A. Restore pavement markings to match those existing in accordance with standard specifications and details and the Owner's Representative's requirements.

3.17 PROTECTION

A. Barricade pavement section from use until concrete has attained minimum design strength.

B. On those sections of pavement to be opened to traffic, seal joints, clean pavement and place earth against pavement edges before permitting use by traffic. Such opening of pavement to traffic shall not relieve Contractor from his responsibility for Work.

C. Maintain concrete paving in good condition until completion of Work.

D. Repair defects by replacing concrete to full depth.

END OF SECTION

SECTION 02523

CONCRETE JOINTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Joints for concrete paving; concrete sidewalks; and curbs, and curb and gutter.

B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.02 UNIT PRICES

A. No separate payment will be made for concrete joints under this Section. Include payment in unit price for Concrete Paving.

B. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.

C. No separate payment will be made for joints or sawcutting for Curb, Curb and Gutter; Concrete Sidewalks; Wheelchair Ramps; and Concrete Driveways. Include payment in unit price for Curb and Gutter; Concrete Sidewalks; Wheelchair Ramps; and Concrete Driveways.

1.03 SUBMITTALS

A. Submit product data and samples in accordance with requirements of all sections and provisions of these specifications.

B. Submit product data for joint sealing compound and proposed sealing equipment for approval.

C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Board Expansion Joint Material: Filler board of selected stock. Use wood of density and type as follows:

1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.

2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

3. Use wood only when part of a load transmission device assembly.

B. Joint Sealing Compound:

1. Joint sealing compound shall be self-leveling Low Modulas Silicone sealant single component meeting the requirements of TxDOT Specification 433.2, Class 5.

C. Load Transmission Devices:

1. Smooth, steel dowel bars conforming to ASTM A615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.

2. Deformed steel tie bars conforming to ASTM A615, Grade 60.

D. Metal Supports for Reinforcing Steel and Joint Assembly: Employ metal supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by the Owner's Representative.

PART 3 E X E C U T I O N

3.01 PLACEMENT

A. When new work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.

B. If the limit of removal of existing concrete or asphaltic pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.

3.02 CONSTRUCTION JOINTS

A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 5 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.03 EXPANSION JOINTS

A. Place 3/4-inch expansion joints at locations shown on drawings. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2

lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings. Seal with joint sealing compound. Maximum spacing shall be 60 feet.

3.04 CONTRACTION JOINTS

A. Place formed groove contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Maximum spacing of contraction/construction joints is 20 feet, or as shown on plans. Polyethylene foam backer rods shall be installed in contraction joints. Seal groove with joint sealing compound.

3.05 LONGITUDINAL WEAKENED PLANE JOINTS

A. Place longitudinal weakened plane joints at spaces indicated on Drawings. Seal groove with joint sealing compound.

3.06 SAWED JOINTS

A. Contractor may use sawed joints as an alternate to formed groove contraction and weakened plane joints. Circular cutter shall be capable of cutting straight line groove 1/4 –3/8" inch wide. Depth shall be one quarter of pavement thickness plus 1/2 inch. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, it shall be continued until completed. Make saw cut with one pass. Complete sawing between 4 to 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.

B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Provide at least one standby saw in good working order. Maintain an ample supply of saw blades at work site at all times during sawing operations. Sawing equipment shall be on job at all times during concrete placement.

3.07 JOINTS FOR CURB, CURB AND GUTTER

A. Place 3/4-inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement; at end of radius returns at street intersections and driveways; and at curb inlets. Maximum spacing shall be 60-foot centers.

3.08 JOINTS FOR CONCRETE SIDEWALKS

A. Provide 3/4-inch expansion joints conforming to ASTM A1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 36 feet. Provide expansion joint material conforming to ASTM D994 for small radius curves and around fire hydrants and

utility poles. Extend the expansion joint material full depth of the slab. Reinforcing bars shall extend 10 inches beyond the expansion joint and then shall be wrapped with building paper, or approved sleeves, so that the 10 inches shall not be bonded to the concrete.

3.09 JOINTS FOR CONCRETE DRIVEWAYS

A. Provide 3/4-inch expansion joints conforming to ASTM D1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab. Where dowels are used, wrap or sleeve one end.

3.10 JOINT SEALING

A. Seal joints only when surface and joints are dry, ambient temperature is within manufacturers' recommendations and weather is not foggy or rainy.

B. Joint sealing equipment shall be in first-class working condition, and be approved by the Owner's Representative. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.

C. Clean joints of loose scale, dirt, dust and curing compound. Term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.

D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch below level of adjacent surface or at elevation as directed.

3.11 PROTECTION

A. Maintain joints in good condition until completion of Work.

B. Replace damaged joints material with new material as required by this Section.

END OF SECTION

SECTION 02525

CONCRETE PAVEMENT CURING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Curing of Portland Cement Concrete Paving.

1.02 UNIT PRICES

A. No separate payment will be made for concrete curing under this Section. Include payment in unit price for Concrete Paving; Concrete Sidewalks; Wheelchair Ramps; and Curb, Curb and Gutter.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds

PART 2 P R O D U C T S

2.01 COVER MATERIALS FOR CURING

A. Curing materials shall conform to one of following:

1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C171.

2.02 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Liquid membrane-forming compounds shall conform to ASTM C309. Membrane shall restrict loss of water to not more than 0.55 kg/m^2 of surface in 72 hours.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Concrete pavement shall be cured by protecting it against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphaltic concrete.

B. Where curing requires use of water, curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

3.02 POLYETHYLENE FILM CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in the form of a fine spray. Cover surface with polyethylene film so film will remain in intimate contact with surface during specified curing period.

B. Cover entire surface and both edges of pavement slab. Joints in film sheets shall overlap minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or by replacing.

3.03 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Immediately after finishing surface, and after concrete has taken its initial set, apply liquid membrane-forming compound in accordance with manufacturer's instructions.

END OF SECTION

SECTION 02530

CONCRETE SIDEWALKS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Reinforced concrete sidewalks.

1.02 UNIT PRICES

A. Measurement for concrete sidewalks is on square foot basis.

B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.

C. Submit manufacturer's certificates giving properties of reinforcing steel. Provide specimens for testing when required by the Owner Representative.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Section 02521.

B. Reinforcing Steel: Conform to material requirements for reinforcing steel of Section 02521.

C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02523.

D. Joint Sealing Compound: Conform to material requirements of Section 02523.

E. Sand Bed: Conform to material requirements for bank run sand of Section 02229.

PART 3 E X E C U T I O N

3.01 REPLACEMENT

A. Replace sidewalks which are removed or damaged during construction with sidewalk of thickness and width equivalent to one removed or damaged.

B. Provide replaced and new sidewalks with wheelchair ramps if sidewalk intersects curb at street or driveway intersection.

3.02 PREPARATION

A. Identify and protect utilities which are to remain.

B. Protect living trees, other plant growth, and features designated to remain.

C. Conduct clearing and grubbing operations in accordance with Section 02100.

D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to the line, grade and cross section. Compact subgrade, to a minimum of 95 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D698.

3.03 PLACEMENT

A. Forms: Straight, unwarped wood or metal forms with nominal 4-inch depth. Securely stake forms to line and grade, and maintain in true position during concrete placement.

B. Reinforcement: Install No. 3 reinforcing steel bars spaced in accordance with Drawing detail. Lay longitudinal bars in walk continuously, through expansion joints in accordance with Section 02523. Support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.

C. Expansion Joints: Install expansion joints in accordance with Section 02523.

D. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.

E. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.

F. Unless otherwise indicated on Drawings, mark off joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.

G. Finish edges with tool having 1/4-inch radius.

H. After concrete has set sufficiently, refill space along sides of sidewalk to top of walk with suitable material. Tamp unit firm and solid. Dispose of excess material in accordance with Section 01564.

3.04 CURING

A. Conform to requirements of Section 02525.

3.05 PROTECTION

A. Maintain sidewalks in good condition until completion of Work.

B. Replace damaged sidewalks in accordance with Paragraph 3.01 in this Section.

3.06 ACCESSIBILITY STANDARDS

A. All sidewalk and wheelchair ramp shall meet criteria of the Texas Accessibility Standards and the Federal Design Guidelines, i.e. slopes, texture and coloring. If applicable, the Texas Department of Licensing and Regulation (TDLR) shall inspect the site and rule on compliance. Any item found out of compliance shall be remedied at the expense of the Contractor.

END OF SECTION

SECTION 02531

CONCRETE DRIVEWAYS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Portland cement concrete driveways.

1.02 UNIT PRICES

A. Measurement for concrete driveways is on square yard basis.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Section 02521.

B. Reinforcing Steel: Conform to material requirements of Section 02521.

C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02523.

D. Joint Sealing Compound: Conform to material requirements of Section 02523.

E. Sand Bed: Conform to material requirements for bank run sand of Section 02229.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Prepare subgrade in accordance with applicable portions of Sections 02221 through 02227 and 02241.

3.02 PLACEMENT

A. Place and finish concrete in accordance with applicable portions of Section 02521.

3.03 JOINTS

A. Install joints in concrete driveway in accordance with Section 02523.

3.04 CONCRETE CURING

A. Cure concrete driveway in accordance with Section 02525.

3.05 PROTECTION

A. Conform to applicable requirements of Section 02525.

END OF SECTION

SECTION 02560

PIPELINE ISOLATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section includes the provisions for pipeline isolation in the existing effluent splitter box and the plant influent lines as shown on the Drawings and as specified herein. Connections to the existing effluent splitter box and plant influent lines shall be made in such a way that allows for the required connections without shutting down daily operation in addition to adding isolation valves. Contractor shall coordinate with operations staff to minimize required shut downs.

B. The Contractor shall provide single source responsibility for the pipeline isolation work performed, including equipment and construction schedule coordination.

1.02 SUBMITTALS

A. General. A detailed engineering submittal package shall be provided in sufficient detail and scope to confirm compliance with the requirements of this section. Submittals shall be complete for all required components. Partial submittals will not be accepted.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01630, Product Options and Substitutions.

C. Shop Drawings. Detailed layout drawings and sequence of construction for all associated pipeline isolation components. Layout drawings shall include:

1. Layout, sequencing, and configuration of all associated equipment and modifications.
2. Detail drawings of isolation assemblies showing components and method of construction.
3. Detail drawings of pipe support components.

D. Product Data.

1. Detailed listing of materials and materials of construction.
2. Product literature.
3. Construction sequencing.

E. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01700, Contract Closeout and Section 01730, Operations and Maintenance Data.

1.03 SYSTEM DESCRIPTION,

A. Existing Conditions.

1. No existing valve exist for the connection to be made at the existing effluent splitter box. If Contractor can make connections without the installation of valves in the time frame of a shutdown allowed by operations staff, that will be permissible. No existing valves or tees exist for diversion of flow from the existing influent lines on site.

B. Design Requirement's. Contractor to provide temporary isolation to the 12-inch clarifier effluent line connecting into the existing effluent splitter box. Once temporarily isolated, Contractor to install permanent 12-inch isolation valve. Contractor is responsible for maintaining daily plant operations and shall only be allowed to temporarily halt plant process operations as approved by Owner. In the event the system cannot be isolated in such a way to continue daily plant operations, Contractor shall utilize bypass pumping to achieve complete isolation of the clarifier discharge lines, at no additional cost to the contract.

PART 2 P R O D U C T S

2.01 ACCEPTED HOT TAPPING AND PLUGGING MANUFACTURERS

1. T.D. Williamson
2. STATS Group
3. Approved substitution.

2.02 ACCEPTED PIPE FREEZING MANUFACTURERS

1. Furmanite
2. Cryostop
3. Approved substitution.

2.03 QUALITY ASSURANCE

A. The Contractor shall provide evidence to the Owners Representative that the manufacturer has a minimum of five (5) years' experience, within the last seven (7) years, in the design, manufacture, and supervision of installation of equipment of the type required under this Specification.

B. The Contractor shall provide evidence to the Owners Representative that equipment which was designed and manufactured by the manufacturer of choice, and which is similar to the equipment required under this Specification, has been in continuous and successful operation in at least five (5) separate facilities for the past five (5) years.

PART 3 E X E C U T I O N

3.01 EXAMINATION

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

B. Beginning of installation indicates Contractor and/or Manufacturer accepts existing conditions.

3.02 INSTALLATION

A. Contractor shall furnish, inspect, store, and install isolation system components in accordance with manufacturer's written instructions and approved submittals.

END OF SECTION

SECTION 02571

PAVEMENT REPAIR FOR UTILITIES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Repairing and resurfacing streets, highways, driveways, sidewalks, curbs and gutters, and other pavements that have been cut, broken, or damaged during construction.

1. Parking areas, service drives, driveways, and sidewalks: Replace with material equal to or better than existing or as indicated on Drawings.

2. Street pavements and curbs, curbs and gutters: Match general pavement type and provide subgrade, base, and surface materials as indicated on the Drawings and as specified in this Section.

B. Repair State highway crossings in accordance with the highway department permit and within 1 week after utility work is installed.

C. Conform to Section 02076 - Removing Existing Pavement and Structures, for removal of existing pavements.

1.02 UNIT PRICES

A. Payment for pavement repair for utilities is on a unit price basis as listed in the Proposal Form.

B. Limits for measurement will be as shown on plans.

C. Total compensation for required Unit Price Work shall be included in Unit Price bid.

D. Quantity and measurement estimates stated in the Agreement are for contract purposes only. Quantities and measurements supplied or placed in the Work and verified by Owner's Representative shall determine payment as stated in Article 6 of the General Conditions.

E. The Contractor will verify all measurements and compute quantities accordingly. The Owner's Representative will verify these quantities.

F. Contractor shall assist by providing necessary equipment, workers, and survey personnel as required by Owner Representative.

1.03 NONCONFORMING PAVEMENT

A. Remove and replace areas of non-conforming Portland cement concrete or asphaltic concrete pavement found deficient in thickness by more than 10 percent, or that fail specified tests, unless accepted by Owner Representative.

1.04 UNIT PRICE ADJUSTMENT

A. For non-conforming pavement, accepted by the Owner Representative, unit price adjustments shall be made for actual in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to lower limit of 90 percent of unit price. No adjustments in price will be made for excess thickness.

1.05 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit test results or other data confirming that materials meet the specified requirements for:

1. Fill, backfill and subgrade materials

2. Base course materials

3. Asphalt materials and mix designs

4. Concrete materials and mix design

5. Joint material

PART 2 P R O D U C T S

2.01 SUBGRADE

A. Provide backfill material as required by Sections 02222 – Borrow, 02221 – Embankment, 02226 – Excavation and Backfill for Structures, 02227 – Excavation and Backfill for Utilities, 02228 – Extra Unit Price Work for Excavation and Backfill, and 02225 – Roadway and Backfill for Roadways.

2.02 BASE COURSE MATERIALS

A. Provide base material as required by applicable portions of Section 02233 Cement Stabilized Base Course, 02231 – Crushed Stone Flexible Base Course, 02234 – Recycled Crushed Concrete Base, and 02238 – Hot Mix Asphaltic Base Course.

2.03 PAVEMENT

A. Provide paving materials as required by applicable portions of Section 02510 - Asphaltic Concrete Pavement, Section 02521 – Concrete Paving, Section 02530 – Concrete Sidewalks, Section 02531 – Concrete Driveways, Section 02532 – Curb, Curb and Gutter, and Headers.

PART 3 E X E C U T I O N

3.01 EQUIPMENT

A. Alternate equipment and methods, other than those required by this section, may be used provided the Contractor demonstrates that equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting pavement in good working order.

3.02 PREPARATION

A. Subgrade: Prepare as required by Sections 02222 – Borrow, 02221 – Embankment, 02226 – Excavation and Backfill for Structures, 02227 – Excavation and Backfill for Utilities, 02228 – Extra Unit Price Work for Excavation and Backfill, and 02225 – Roadway and Backfill for Roadways.

B. Base: Prepare base material as required by applicable portions of Section 02233 Cement Stabilized Base Course, 02231 – Crushed Stone Flexible Base Course, 02234 – Recycled Crushed Concrete Base, and 02238 – Hot Mix Asphaltic Base Course.

C. Pavement: Provide paving materials as required by applicable portions of Section 02510 - Asphaltic Concrete Pavement, Section 02521 – Concrete Paving, Section 02530 – Concrete Sidewalks, Section 02531 – Concrete Driveways, Section 02532 – Curb, Curb and Gutter, and Headers.

D. Notify the Owner Representative prior to commencement of excavation in pavement for which an excavation in public right of way permit has been obtained. Follow directions contained in the permit.

E. Conform to requirement of Section 02076 – Remove Existing Pavements and Structures, for removals.

F. When removing pavement to existing deformed metal strip, saw cut pavement a minimum of two inches deep on opposite side of deformed metal strip. Place saw joint far enough behind deformed metal strip to obtain continuously straight joint. Remove

damaged portion of deformed metal strip as required to provide proper joint. Saw cut and remove metal strip before placement of new concrete pavement.

G. Protect edges of existing pavement to prevent damage during removals, utility placement, backfill and paving operations. For concrete pavement, protect undisturbed subgrade that is to remain to support replacement slab.

H. Dowel in to existing pavement where no reinforcement is found or is broken due to construction activities. Unless otherwise directed by the Owner Representative, provide No. 6 reinforcing bars twenty four inches long, drilled and embedded twelve inches into center of existing slab with "PO-ROC" epoxy grout or approved equal. Space dowels to match new pavement reinforcement spacing.

I. Provide transitional paving, additional base depth and undercutting of existing pavement as required to tie proposed pavement to existing pavement when unable to dowel new pavement into existing pavement.

J. Temporarily fill hole with base material or bridge with three-quarter inch steel plates until ready to place concrete.

3.03 INSTALLATION

A. Parking Areas, Service Drives, Driveways and Sidewalks: Replace with material equal to or better than existing or as indicated on the Drawings. Conform to applicable requirements of sections referenced in Paragraph 2.01 Materials.

B. Street Pavements and Curbs, Curbs and Gutters: Replace subgrade, base and surface course with like materials or as indicated on the drawings and the City of Galveston Standard Details and Technical Specifications. Curbs and curbs and gutters shall match existing. Conform to requirements of sections referenced in Paragraph 2.01 Materials.

C. For concrete pavement, install size and length of reinforcing steel and pavement thickness indicated on the Drawings and the City of Galveston Standard Details and Technical Specifications. Place types and spacing of joints to match existing joints or as indicated on the Drawings.

D. Where existing pavement consists of concrete pavement with asphaltic surfacing, match existing thickness of the concrete pavement and asphalt surfacing.

E. Repair TxDOT highway and county crossings in accordance with TxDOT permit or county requirements as appropriate, and within one week after pavement removal.

3.04 WASTE MATERIAL DISPOSAL

A. Dispose of waste material in accordance with requirements of Section 01564 – Waste Material Disposal.

3.05 PROTECTION

A. Maintain pavement in good condition until completion of the Work.

B. Replace pavement damaged by the Contractor's operations at not cost to the Owner.

END OF SECTION

SECTION 02584

PRECAST UNDERGROUND PULL BOXES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section includes the requirements for the provision of precast polymer concrete boxes and covers for underground duct and conduit systems. The material consists of aggregate bonded with a polyester resin and reinforced with continuous woven glass strands.

B. Installations shall be in areas where no deliberate vehicular traffic is planned.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. Brooks Products.

B. “Quazite” by Strongwell.

C. Or approved substitution.

2.02 COVERS AND BOXES

A. The covers and boxes shall be designed to be installed flush to grade with the cover fitting flush to the box.

B. The covers shall be skid resistant and have a minimum coefficient of friction of 0.50 on the top surface for the life of the cover. Coatings will not be approved.

C. The cover logo shall be recessed into the cover and shall read “Electrical" or "Control”, as applicable.

D. The lockdown mechanism shall be capable of withstanding a minimum torque of 30 foot-pounds. All inserts and fasteners shall be of stainless steel.

E. The covers and boxes shall be capable of withstanding normal shipping and installation practices with no chipping, cracking, or loss of structural integrity.

F. All boxes shall be manufactured with the use of male/female molds to ensure a consistent wall of thickness and structural strength.

G. The boxes shall be a minimum of 45% nestable for ease in transportation and storage.

H. The boxes and covers pertaining to this specification shall have minimum cover dimensions of 17 inches by 30 inches and a minimum box depth of 30 inches, unless shown otherwise.

I. Provide cable support and inserts for fiber-optic and control cable bundles.

2.03 STRUCTURAL REQUIREMENTS

A. Cover Vertical Load. The covers shall be designed for a static vertical load of 8,000 pounds and shall be tested, in the box, to a static load of 12,000 pounds (1.5 safety factor). The test load shall be distributed through a 10" x 10" x 1" thick steel distribution plate with a 10" x 10" x 1/2" rubber backing plate centered on the cover. The 12,000-pound load must be cycled ten times. On the tenth cycle, the load shall be increased until failure of the cover occurs. The failure load and the cover weight shall be recorded in the test results.

B. Cover Impact. Any point on the covers shall withstand a 70 ft.-lb. impact administered with a 12 lb. weight without puncturing or splitting, in accordance with ASTM D2444. The test shall be performed with the cover resting on a flat, rigid surface such as a concrete slab or a one inch thick steel plate.

C. Box Vertical Load. The boxes shall be designed for a static vertical load of 8,000 pounds and shall be tested, with the cover in place, to a static load of 12,000 pounds. The base shall be fully supported with a rigid material. The same loading plates shall be used as in paragraph 2.2A. Vertical load testing is required in two positions. The first position is centered on the top of the long wall of the box. The distribution plate shall be positioned so that a 5" x 10" rectangular portion of the plate is in contact with the box and cover. The second vertical load testing position shall be on a top corner of the box. The distribution plate shall be positioned so that a 7" x 7" square portion of the plate is in contact with the corner of the box and cover. The 12,000 pound test load must be cycled ten times. On the tenth cycle, the load shall be increased until failure of the box occurs. The failure load and the box weight shall be recorded in the test results.

D. Box Lateral Load. The box, with the cover in place, shall be tested to withstand a lateral bearing pressure of 600 pounds per square foot to simulate soil loading. The test load shall be 600 pounds per square foot multiplied by the square footage of the longest side of the box. The box shall be supported with a suitable medium, which will conform to the shape and angle of the box sidewall (such as sand). The test load shall be applied through an 18" x 24" x 1" steel loading plate with an 18" x 24" x 1/2" backing centered on the longest side of the box. The loading plate shall bear against a suitable medium, which will evenly conform to the shape and angle of the box sidewall to ensure uniform loading. A deflection measuring device will be positioned to measure the relative deflection between the testing machine table and the inside of the loaded sidewall of the box. If a compressible medium is used for a reaction base, its deflection to yield the net

deflection of the sidewall of the box. The maximum deflection at the test load must be less than 1/4" per foot of length of the box. The test load must be cycled ten times. On the tenth cycle, the load shall be increased until failure of the box occurs. The failure load and the box weight shall be recorded in the test results. The failure load must be a minimum of twice the test load.

E. The permanent deflection of any surface shall not exceed 10% of the maximum allowable test load deflection.

F. The test sample weight must not vary from the published product weights by more than 10%.

2.04 MATERIAL REQUIREMENTS

A. The material specimen samples shall have the following characteristics:

Material Designation	**Compressive Strength**	**Tensile Strength**	**Flexural Strength**
Standard Weight	11,000 psi	1,700 psi	7,500 psi

B. The material shall be tested according to the requirements of ASTM D543, Section 7, Procedure 1, for chemical resistance, using the following chemicals in the concentrations noted:

Chemical	**Concentrated**
Sodium Chloride	5%
Sulfuric Acid	0.1 N
Sodium Carbonate	0.1 N
Sodium Sulfate	0.1 N
Hydrochloric Acid	0.2 N
Sodium Hydroxide	0.1 N
Acetic Acid	5%
Kerosene	Per ASTM D543
Transformer Oil	Per ASTM D543

C. The manufacturer is responsible for proof of compliance with the latest version of the following ASTM Standards.

1. ASTM D756, Procedure E, Accelerated Service Exposure.

2. ASTM G53, Recommended Practice for Operating Light B and Water-Exposure of Non-Metallic Materials (with a U.V.A. 340 bulb).
3. ASTM D570, Section 5, 6.1, 6.5, Water Absorption.
4. ASTM D790, Flexural Properties.
5. ASTM D635, Flammability Test.

D. Except for the flammability test, the minimum materials acceptance criteria shall be: retention of 75% of the control specimen values for load and deflections, no more than 2% change in weight or any dimension, no visual cracking, crazing, checking, blistering, or surface pitting. For the flammability test, the burning rate must be less than 0.3 inches in length for each 0.1 inches of thickness.

PART 3 E X E C U T I O N

3.01 LOCATION AND INSPECTION

A. Construct pullboxes where shown on the drawings. Final location may be adjusted slightly to fit actual field conditions. For locations not shown on drawings, provide pull-boxes every 100 feet in runs of direct-buried conduit. For straight runs of buried conduit, interval may be extended to 200 feet between pullboxes. Coordinate interval with conduit and conductor supplier. Do not exceed maximum pulling intervals recommended by manufacturers of fiber-optic and copper-conductor control wires.

B. Before beginning excavation operations stake out the proposed pullbox locations and obtain approval of the Owner's Inspector.

3.02 EXCAVATION AND BACKFILL

A. Perform all necessary excavation and backfill for proper installation of pullboxes. Use excavated soil for backfill and supplement as necessary with select materials. Compact all backfill and restore adjacent areas disturbed by excavation and backfilling operations to a condition equal to the original.

3.03 PLACING OF CONCRETE

A. Set concrete formwork and place concrete reinforcement as required. After concrete has been placed and formwork has been removed, fill voids and properly patch concrete surfaces.

3.04 CLEANING

A. Before any equipment or cable is installed, remove all dirt and debris and pump out the pullbox so that it is free of standing water.

END OF SECTION

SECTION 02601

PRECAST CONCRETE MANHOLES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Precast concrete sanitary sewer manholes.

B. Precast concrete sanitary sewer manholes with spray-in liner where corrosion-resistant manholes are specifically indicated in the Drawings.

1.02 UNIT PRICES

A. Measurement and payment for normal depth manholes, up to 8 feet deep, is on a unit price basis for each manhole installed. Depth is measured from top of cover to sewer invert.

B. Measurement and payment for shallow depth manholes is on a unit price basis for each manhole installed. Shallow manholes have a depth of 4 feet or less measured from the top of cover to sewer invert.

C. Measurement and payment for extra depth manholes is on a unit price basis per vertical foot for each foot of depth greater than 8 feet. Depth is measured from top of cover to sewer invert.

D. Measurement and payment for normal depth corrosion resistant manholes, up to 8 feet deep, is on a unit price basis for each manhole installed. Depth is measured from top of cover to sewer invert.

E. Measurement and payment for extra depth corrosion resistant manholes is on a unit price basis per vertical foot for each foot of depth greater than 8 feet. Depth is measured from top of cover to sewer invert.

F. Measurement and payment for normal depth standard manhole drops up to 3 feet deep is on a unit price basis for each drop installed. Depth is measured from the invert of the T-fitting to the sewer invert. Standard manhole drops include both internal and external drops.

G. Measurement and payment for extra depth manhole drops is on a unit price basis per vertical foot for each foot of depth greater than 3 feet. Depth is measured from the invert of the T-fitting to the sewer invert. Standard manhole drops include both internal and external drops.

1.03 SUBMITTALS

A. Conform to requirements of all sections and provisions of these specifications.

B. Submit manufacturer's data and details of following items for approval:

1. Shop drawings of manhole sections and base units and construction details, including reinforcement, jointing methods, materials and dimensions.

2. Certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in paragraph 2.01 E of this specification.

3. Frames, grates, rings, and covers.

4. Materials to be used in fabricating drop connections.

5. Materials to be used for pipe connections at manhole walls.

6. Materials to be used for stubs and stub plugs, if required.

7. Materials and procedures for corrosion-resistant liner and coatings, if required.

8. Plugs to be used for sanitary sewer hydrostatic testing.

9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches.

PART 2 P R O D U C T S

2.01 PRECAST CONCRETE MANHOLES

A. Use manhole sections and base sections conforming to ASTM C 478. Use base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of the manufacturer of the manhole sections meeting material requirements of ASTM C 478. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

B. Construct barrels for precast manholes from 48-inch diameter standard reinforced concrete manhole sections unless otherwise indicated on Drawings. Use various lengths of manhole sections in combination to provide the correct height with the fewest joints. Wall sections shall be designed for depth as shown and loading conditions as described in paragraph 2.01E, but shall not be less than 5 inches thick. Base section shall have a minimum thickness of 12 inches under the invert.

C. Provide cone tops to receive cast iron frames and covers, unless indicated otherwise. Use tops designed to support an H-20 loading.

D. Where the Drawings indicate that manholes larger than 48-inch diameter are required, precast base sections of the required diameter shall be provided with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric. The transition shall be located to provide a minimum of 7-foot head clearance from the top of bench to underside of transition.

E. Design Loading Criteria: The manhole walls, transition slabs, cone tops, and manhole base slab shall be designed by the manufacturer to the requirements of ASTM C 478 for the depth as shown on Drawings and the following design criteria:

1. AASHTO H-20 loading applied to the manhole cover and transmitted down to the transition and base slabs.

2. Unit soil weight of 120 pcf located above all portions of the manhole, including base slab projections.

3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf, with soil pressure acting on empty manhole.

4. Internal liquid pressure based on a unit weight of 63 pcf, with manhole filled with liquid from invert to cover, with no balancing external soil pressure.

5. Dead load of manhole sections fully supported by the transition and base slabs.

6. Design additional reinforcing steel to transfer stresses at openings.

7. The minimum clear distance between any two wall penetrations shall be 12 inches or half the diameter of the smaller penetration, whichever is greater.

F. Form joints between sections with O-ring gaskets conforming to ASTM C 443.

G. Do not incorporate manhole steps in manhole sections.

H. Do not use brick masonry in construction of sanitary sewer manholes.

2.02 CONCRETE

A. Conform to requirements of Section 03305 - Concrete for Utility Construction.

B. Channel Inverts: Concrete for inverts not integrally formed with manhole base shall be either 5 sack premix (bag) concrete or Class A concrete, with a minimum compressive strength of 4000 psi.

C. Cement Stabilized Sand Foundation: Provide cement stabilized sand foundation under base section in lieu of foundation slab, where allowed, conforming to requirements of Section 02252 - Cement Stabilized Sand.

D. Concrete Foundation: Use Class A concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

2.03 REINFORCING STEEL

A. Reinforcing steel shall conform to requirements of Section 03305 - Concrete for Utility Construction.

2.04 MORTAR

A. Conform to requirements of ASTM C 270, Type S using Portland cement.

2.05 MISCELLANEOUS METALS

A. Provide cast-iron frames, rings, and covers conforming to requirements of Section 02603 - Frames, Grates, Rings and Covers.

2.06 DROP CONNECTIONS AND STUBS

A. Drop connections and stubs shall conform to the same pipe material requirements used in the main pipe, unless otherwise indicated on the Drawings.

2.07 PIPE CONNECTIONS FOR SANITARY SEWERS

A. Use resilient connectors conforming to requirements of ASTM C 923. Metallic mechanical devices as defined in ASTM C 923 shall be made of the following materials:

1. External clamps: Type 304 stainless steel

2. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gage minimum.

3. Internal, expandable clamps on corrosion-resistant manholes:

a. Type 316 stainless steel, 11 gage minimum, or

b. Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C 213.

B. Where rigid joints between pipe and a cast-in-place manhole base are specified or shown on the Drawings, use polyethylene-isoprene waterstop meeting the physical property requirements of ASTM C 923, Press-Seal WS Series, or equal.

2.08 SEALANT MATERIALS

A. Sealing materials between precast concrete adjustment ring and manhole cover frame shall be Adeka Ultraseal P201, or approved equal.

2.09 CORROSION RESISTANT MANHOLE MATERIALS

A. Manholes shall be corrosion resistant only if stated on the drawings. The materials shall be applied by an approved certified applicator. Acceptable material is:

1. Raven 405 as manufactured by Raven Lining Systems, Inc., Tulsa, Oklahoma. The corrosion resistant barrier shall be spray applied as per the manufacturer's recommendation and shall have a minimum finished dry film thickness of 100 mils.

B. The Contractor shall have manufacturer's representative present on site at all times during the installation of corrosion resistant barrier

C. The Contractor shall make provisions in his unit price bid for each structure to maintain dry conditions for the corrosion resistant liner application and subsequent curing as per manufacturer's recommendations.

2.10 BACKFILL MATERIALS

A. Backfill materials shall conform to the requirements of Section 02227 - Excavation and Backfill for Utilities.

2.11 NON-SHRINK GROUT

A. For non-shrink grout, use prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. It shall meet the requirements of ASTM C 1107 and shall have a minimum 28-day compressive strength of 7000 psi.

2.12 PROHIBITED MATERIALS

A. Do not use brick masonry for construction of sanitary sewer manholes, including adjustment of manholes to grade. Use only specified materials listed above.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify lines and grades are correct.

B. Determine if the subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. If it cannot be compacted to that density, the subgrade shall be moisture conditioned until that density can be reached or shall be treated as an unstable subgrade.

C. Do not build sanitary sewer manholes in ditches, swales, or drainage paths unless directed by the Owner Representative.

3.02 PLACEMENT

A. Install precast manholes to conform to locations and dimensions shown on Drawings.

B. Place manholes at points of change of alignment, grade, size, pipe intersections, and end of sewer.

3.03 MANHOLE BASE SECTIONS AND FOUNDATIONS

A. Place precast base on 12-inch-thick (minimum) foundation of cement stabilized sand or a concrete foundation slab. Compact cement-sand in accordance with requirements of Section 02252 - Cement Stabilized Sand.

B. Unstable Subgrade Treatment: When unstable subgrade is encountered, the subgrade will be examined by the Owner Representative to determine if the subgrade has heaved upwards after being excavated. If heaving has not occurred, the subgrade shall be over-excavated to allow for a 24-inch thick layer of crushed stone wrapped in filter fabric as the foundation material under the manhole base. If there is evidence of heaving, a pile-supported concrete foundation, as detailed on the Drawings, shall be provided under the manhole base, when indicated by the Owner Representative.

3.04 PRECAST MANHOLE SECTIONS

A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.

B. Install precast adjustment rings above tops of cones or flattop sections as required to adjust the finished elevation and to support manhole frame.

C. Seal any lifting holes with non-shrink grout.

D. Where corrosion resistant lining is required, seal joints between sections in accordance with manufacturers recommendations.

3.05 PIPE CONNECTIONS AT MANHOLES

A. Install approved resilient connectors at each pipe entering and exiting sanitary sewer manholes in accordance with manufacturer's instructions.

B. Ensure that no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter the space between the pipe and the edge of the wall opening at and around the resilient connector on either the interior or exterior of the manhole. If necessary, fill the space with a compressible material to guarantee the full flexibility provided by the resilient connector.

C. Test connection for watertight seal before backfilling.

3.06 INVERTS FOR SANITARY SEWERS

A. Construct invert channels to provide a smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inch per foot maximum

2. Depth of bench to invert:

a. Pipes smaller than 15-inches: one-half largest pipe diameter

b. Pipes 15 to 24-inches: three-fourths the largest pipe diameter.

c. Pipes larger than 24-inches: equal to the largest pipe diameter

3. Invert slope through manhole: 0.10-foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.07 DROP CONNECTIONS FOR SANITARY SEWERS

A. Backfill drop assembly with cement stabilized sand or Class A concrete to form a solid mass. Extend cement stabilized sand or concrete encasement a minimum of 4 inches outside of bells.

B. Install a drop connection when a sewer line enters a manhole higher than 30-inches above the invert of a manhole.

3.08 STUBS FOR FUTURE CONNECTIONS

A. In manholes, where future connections are indicated on the Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.09 MANHOLE FRAME AND ADJUSTMENT RINGS

A. Combine precast concrete adjustment rings so that the elevation of the installed casting cover is 3/8 inch below the pavement surface. Seal between adjustment ring and the precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply a latex-based bonding agent to precast concrete surfaces to be joined with non-shrink grout. Set the cast iron frame on the adjustment ring in a bed of approved sealant. The sealant bed shall consist of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 3/4-inch wide.

B. For manholes in unpaved areas, top of frame shall be set a minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase the manhole frame in mortar or non-shrink grout placed flush with the face of the

manhole ring and the top edge of the frame. Provide a rounded corner around the perimeter.

3.10 BACKFILL

A. Place and compact backfill materials in the area of excavation surrounding manholes in accordance with requirements of Section 02227 - Excavation and Backfill for Utilities. Use embedment zone backfill material, as specified for the adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to the manhole. Provide trench zone backfill, as specified for the adjacent utilities, above the embedment zone backfill.

B. Where rigid joints are used for connecting existing sewers to the manhole, backfill under the existing sewer up to the springline of the pipe with Class B concrete or flowable fill.

C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide a minimum of 4 inches of topsoil conforming to requirements of Section 02920 - Topsoil. Seed in accordance with Section 02932 - Hydromulch Seeding. If shown on Drawings, sod disturbed areas in accordance with Section 02935 - Sodding.

3.11 FIELD QUALITY CONTROL

A. Conduct leakage testing of manholes in accordance with requirements of Section 02732 - Acceptance Testing for Sanitary Sewers.

3.12 PROTECTION

A. Protect manholes from damage until work has been finally accepted. Repair damage to manholes at no additional cost to Owner.

END OF SECTION

SECTION 02603

FRAMES, GRATES, RINGS, AND COVERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings and extensions.

B. Ring grates.

1.02 UNIT PRICES

A. No payment will be made for frames, grates, rings, covers, and seals under this Section. Include payment in unit price for related item.

1.03 SUBMITTALS

A. Submit product data in accordance with all sections and provisions of these specifications.

B. Provide copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.

C. Provide shop drawings for fabrication and erection of casting assemblies. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

PART 2 P R O D U C T S

2.01 CASTINGS

A. Castings for frames, grates, rings and covers shall conform to ASTM A48, Class 30. Provide locking covers if indicated on Drawings.

B. Castings shall be capable of withstanding the application of an AASHTO H-20 loading without permanent deformation.

C. Fabricate castings to conform to the shapes, dimensions, and with wording or logos shown on the Drawings.

D. Castings shall be clean, free from blowholes and other surface imperfections. Cast holes in covers shall be clean and symmetrical, free of plugs.

E. Castings shall be made in U.S.A.

F. Manhole cover and frame shall be called PAMREX or approved equal. Cover and frame shall be manufactured from ductile iron.

Covers shall be dually hinged and incorporate a 90 degree blocking system to prevent accidental closure. Covers shall be one man operable using standard tools and shall be capable of withstanding a test load of 80,000 lbs.

Frames shall be circular, incorporate a seating ring and a fitted plug in each hinge housing, and be available in a 32-inch clear opening. The frame depth shall not exceed 5-inches, and the flange shall incorporate bedding slots, bolt holes, and lifting eyes.

All components shall be black coated.

Frame weight: 107 lbs.
Cover weight: 162 lbs.
Total weight: 269 lbs.

DIMENSIONS (INCHES)			WEIGHT (lbs)		
A	O	H	COVER AND FRAME	COVER ONLY	REFERENCE
39 4/10	32	5	269	162	RE 32 R8 FD

2.02 BEARING SURFACES

A. Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for any position in which the casting may be seated in the frame.

2.03 FABRICATED RING GRATES

A. Ring grates shall be fabricated from reinforcing steel conforming to ASTM A615.

B. Welds connecting the bars shall conform to AWS D12.1.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install castings according to approved shop drawings, instructions given in related specifications, and applicable directions from the manufacturer's printed materials.

B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in formwork until permanently set.

C. Ring grates shall be fabricated in accordance with drawings and shall be set in mortar in the mouth of the pipe bell.

END OF SECTION

SECTION 02604

VALVE BOXES, METER BOXES, AND METER VAULTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Valve boxes for water service.

B. Meter boxes for water service.

C. Meter vaults for water service.

1.02 UNIT PRICES

A. No separate payment will be made for valve boxes under this section. Include payment in unit price for Section 02640 - Gate Valves.

B. Measurement for meter vaults is on a lump sum basis or installation of each meter vault type and size. Payment will be made for each vault installed regardless of depth.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all section and provisions of these specifications.

B. Submit manufacturer’s product data for following items for approval:

1. Each type of valve box and lid.

2. Each type of meter box and cover.

3. Each type of meter vault frame and cover.

C. Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from Drawings.

D. Submit manufacturer's certification that plastic meter boxes purchased for Work meet the requirements of paragraph of this Section on Plastic Meter Boxes.

PART 2 P R O D U C T S

2.01 VALVE BOXES

A. Provide Type "A", cast-iron, slide-type, valve boxes. Design of valve box shall minimize stresses on valve imposed by loads on box lid.

B. Cast a letter "W" into lid, 1/2 inch in height and raised 3/32 inch, for valves serving potable water lines.

C. Coat boxes, bases, and lids by dipping in hot bituminous varnish.

D. Provide 6-inch PVC, Class 150, DR 18, riser pipes.

E. Concrete for valve box placement:

1. For locations in new concrete pavement, use strength and mix design of new pavement.

2. For other locations, use class "A" concrete, with minimum compressive strength of 3000 psi, conforming to requirements of Section 03305.

2.02 METER BOXES GENERAL

A. The Owner will furnish all meter boxes for meters 1 1/2-inch and smaller.

2.03 METER VAULTS

A. Meter vaults may be constructed of precast concrete, cast-in-place concrete, or solid masonry unless a specific type of construction is required by Drawings.

B. Concrete for meter vaults: Class A concrete, conforming to requirements of Section 03305, with minimum compressive strength of 4000 psi at 28 days.

C. Reinforcing steel for meter vaults: Conform to requirements of Section 03305.

D. Grates and Covers: Conform to requirements of Section 02603.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Obtain approval from the Owner Representative for location of meter vault.

B. Verify lines and grade are correct.

C. Verify compacted subgrade will support loads imposed by vaults.

3.02 VALVE BOXES

A. Provide riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade. Install with bell on top of valve.

B. Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of

valve box, for vertical movement damping. Riser may rest on valve flange, or provide suitable footpiece to support riser pipe.

C. After valve box has been set, aligned, and adjusted so that lid is level with final grade, pour a 24-inch by 24-inch by 8-inch thick concrete block around valve box. Center valve box horizontally within concrete block.

D. Paint covers of new valve boxes in Blue (color approved by owner) when installed. This work is incidental and no separate payment will be made.

3.03 METER BOXES

A. Install plastic boxes in accordance with manufacturer's instructions.

B. Construct concrete meter boxes to dimensions shown on Drawings.

C. Adjust top of meter boxes to conform to cover elevations specified in paragraph of this section for Frame and Cover for Meter Vaults.

D. Do not locate under paved areas unless approved by Owner Representative. Use approved traffic-type box with cast iron lid when meter must be located in paved areas.

3.04 METER VAULTS

A. Construct concrete meter vaults to dimensions and requirements shown on drawings. Do not cast in presence of water. Make bottom uniform.

B. Precast Meter Vaults:

1. Install precast vaults in accordance with manufacturer's recommendations. Set level on a minimum 3-inch thick bed of sand conforming to the requirements of Section 02229.

2. Seal lifting holes cement-sand mortar or non-shrink grout.

C. Meter Vault Floor Slab:

1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center, or install mortar trench for keying walls to floor slab.

2. Precast floor slab elements may be used for precast vault construction

D. Cast-in-Place Meter Vault Walls:

1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.

2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 Feet.

3. Set frame for cover while concrete is still green.

3.05 FRAME AND COVER FOR METER VAULTS

A. Set cast iron frame in a mortar bed and adjust elevation of cover as follows:

1. In unpaved areas, set top of meter box or meter vault cover 1 to 2 inches above natural grade.

2. In sidewalk areas, set top of meter box or meter vault cover level with adjacent concrete.

3.06 BACKFILL

A. Provide bank run sand in accordance with Section 02229, and backfill and compact in accordance with Section 02227.

B. In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope 1 to 5 from top to natural grade.

C. In sidewalk areas slope concrete down from meter boxes to meet adjacent concrete.

END OF SECTION

SECTION 02607

ADJUSTING MANHOLES, INLETS, AND VALVE BOXES TO GRADES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Adjusting elevation of existing manholes, inlets, and valve boxes to new grades.

1.02 UNIT PRICES

A. Measurement for adjusting utility structures to grade is on a lump sum basis for:

1. Adjusting manholes.

2. Adjusting inlets.

3. Adjusting valve boxes.

PART 2 P R O D U C T S

2.01 CONCRETE MATERIALS

A. For cast in place concrete, refer to Section 03305 - Concrete for Utility Construction.

B. For precast concrete manhole sections and adjustment rings, refer to Section 02601 - Precast Concrete Manholes.

C. For mortar mix, conform to requirements of ASTM C 270, Type S using Portland cement.

2.02 CAST IRON ADJUSTING RINGS

A. For cast iron adjusting rings, refer to Section 02603 - Frames, Grates, Rings and Covers.

2.03 PIPING MATERIALS

A. For riser pipes and fittings, refer to applicable piping materials specifications in Sections 02610 through 02620.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, and piping and connections for damage or defects that would affect adjustment to grade. Report such damage or defects to the Owner Representative.

3.02 ESTABLISHING GRADE

A. Coordinate grade related items with existing grade and finished grade or paving, and relate to established bench mark or reference line.

3.03 ADJUSTING MANHOLES AND INLETS

A. Elevation of manhole or inlet can be raised using precast concrete rings or metal adjusting rings. Use of brick for adjustment of sanitary sewer manholes to grade is prohibited. Elevation of manhole or inlet can be lowered by removing existing masonry, adjusting rings or the top section of the barrel below the new elevation and then rebuilding or raising the elevation to the proper height.

B. Grout inside and outside adjusting ring joints.

C. Salvage and reuse cast iron frame and cover or grate.

D. Protect or block off manhole or inlet bottom using wood forms shaped to fit so that no debris or soil falls to the bottom during adjustment.

E. Set the cast iron frame for the manhole cover or grate in a full mortar bed and adjust to the established elevation. In streets, adjust covers to pavement elevation.

F. Verify that manholes and inlets are free of visible leaks as a result of reconstruction. Repair leaks in a manner subject to the Owner Representative's approval.

3.04 ADJUSTING VALVE BOXES

A. Salvage and reuse valve box and surrounding concrete block.

B. Remove and replace 6-inch riser pipe in accordance with City’s standard details with suitable length for depth of cover required to establish the adjusted elevation to accommodate actual finish grade.

C. Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.

D. After valve box has been set, aligned, and adjusted so that top lid is level with final grade, pour a 24-inch by 24-inch by 8-inch thick concrete pad around valve box. Center valve box horizontally within concrete slab.

3.05 BACKFILL AND GRADING

A. Backfill the area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of Section 02227 - Excavation and Backfill for Utilities.

B. Grade the ground surface to drain away from each manhole and valve box. Place earth fill around manholes to the level of the upper rim of the manhole frame. Place earth fill around the valve box concrete block.

C. In unpaved areas, grade surface at a uniform slope of 1 to 5 from the manhole frame to natural grade.

END OF SECTION

SECTION 02610

DUCTILE IRON PIPE AND FITTINGS

PART 1 G E N E R A L

.01 SECTION INCLUDES

A. Ductile iron pipe and fittings for water mains, wastewater force mains, encasements, and gravity sanitary sewers.

.02 UNIT PRICES

A. Payment will be made for Ductile Iron pipe on a linear foot basis.

B. No separate payment will be made for ductile iron or PVC fittings under this Section. Include cost in unit price for water mains, force mains, gravity sanitary sewers, and storm sewers.

.03 SUBMITTALS

A. Conform to requirements of all sections and provisions of these specifications.

B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fitting, flange, and special details. Show station numbers for pipe and fittings corresponding to Drawings.

C. Production of pipe and fittings prior to review by the Owner’s Representative is at Contractor's risk.

.04 QUALITY CONTROL

A. Provide manufacturer's certifications that all ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A21.51.

B. Provide certifications that all pipe joints have been tested and meet requirements of ANSI A21.11.

PART 2 P R O D U C T S

.01 DUCTILE IRON PIPE

A. Ductile iron pipe barrels: ANSI A21.15, ANSI A21.50 or ANSI A21.51; bear mark of Underwriters' Laboratories approval; pressure classes as shown on the Drawings and/or Bid Proposal.

B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings and/or Bid Proposal.

.02 JOINTS

A. Joint types: ANSI A21.11 push-on; ANSI A21.11 mechanical joint; or ANSI A21.15 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, bolts shall conform to requirements of AWWA C111.

B. Where restrained joints for buried service are required by Drawings, provide Series 1100 (MEGALUG) by EBAA Iron Inc., or equal.

C. Threaded or grooved type joints which reduce pipe wall thickness below minimum required are not acceptable.

D. Provide for restrained joints designed to meet test pressures required under Section 02676- Hydrostatic Testing of Pipelines or Section 02731 - Sanitary Sewage Force Mains, as applicable.

E. Where ductile iron water main is cathodically protected from corrosion, bond rubber gasketed joints as shown on Drawings to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings.

.03 GASKETS

A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material; for flanged joints 1/8-inch thick gasket in accordance with ANSI A21.15.

B. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed pipeline, shall have the following gasket materials for the noted contaminants:

Contaminant	Gasket Material Required
Petroleum (diesel, gasoline)	Nitrile Rubber
Other contaminants	As recommended by the pipe manufacturer

.04 FITTINGS

A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they serve.

B. Push-on Fittings will not be allowed.

C. Flanged Fittings: ANSI A21.10; ANSI B16.1 cast or ductile iron. Flanges: ANSI B16.1, Class 125; pressure rated at 250 psig.

D. Mechanical Joint Fittings: ANSI A21.10 (AWWA C110); pressure rated at 250 psi.

E. Ductile Iron Compact Fittings for Water Mains: ANSI A21.53 (AWWA C153); 4-inch through 12-inch diameter; fusion bonded epoxy-lined or cement-mortar lining; conform to requirements of Section 02630 - Polyethylene Wrap.

.05 COATINGS AND LININGS

A. Water Main Interiors: ANSI A21.4, cement lined with seal coat.

B. Sanitary Sewer and Force Main Interiors:

1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.

2. Liner thickness: Nominal 40 mils, minimum 35 mils, for pipe barrel interior; minimum 6 - 10 mils at gasket groove and outside spigot end to 6-inches back from end.

3. Testing: ASTM G62, Method B for voids and holidays; provide written certification.

4. Acceptable Lining Materials:

a. Virgin polyethylene conforming to ASTM D1248, with inert fillers and carbon black to resist ultraviolet degradation during storage heat bonded to interior surface of pipe and fittings; APolyline@ by American Cast Iron Pipe Company; or equal.

b. Polyurethane: Corro-pipe II by Madison Chemicals.

c. Ceramic Epoxy: Protecto-401 by Enduron Protective Coatings.

C. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with

seal coat in accordance with ANSI A21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B.

1. Water Lines

   a. Auger Holes: Conform to requirements of Section 02629 - Polyurethane Coatings on Steel or Ductile Iron Pipe.

   b. Above Ground (or Exposed): Conform to the following:

Provide a 3-coat epoxy/polyurethane coating system as designated below.

Surface Preparation	SSPC SP10 Near White Blast Clean 2.0 to 3.0 mils surface profile
Prime Coat 2.0 to 4.0 mils DFT	ACRO 4422 Inhibitive Epoxy Primer, or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	ACRO 4460 Chemical Resistant Epoxy, or approved equal
Finish Coat 1.5 to 2.0 mils DFT	ACRO 4428 Polyurethane, Or approved equal

   c. Total minimum allowable dry film thickness for system: 10 mils.

   d. All materials shall be from same manufacturer.

   e. Color of paint shall be in accordance with the City's standard.

2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.

c. Total minimum allowable dry film thickness for system: 10 mils.

d. All materials shall be from same manufacturer.

e. Color of paint shall be in accordance with the City's standard.

2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.

.06 GRADE

A. Unless otherwise specified on Drawings, install ductile iron pipe for water service to clear utility lines with following minimum cover:

B.

Diameter (Inches)	Depth of Cover (Feet)
16 and 24	5
12 and smaller	3.5

3.03 FIELD REPAIR OF COATINGS

A. Polyurethane: Conform to requirements of Section 02629 - Polyurethane Coatings for Steel or Ductile Iron Pipe.

B. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A21.16.

END OF SECTION

SECTION 02611

STEEL PIPE AND FITTINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. New steel pipe and fittings for pumping facilities, and casings.

1.02 UNIT PRICES

A. No payment will be made for steel pipe and fittings under this section. Include cost in unit price for water pumping facilities and casings.

1.03 SUBMITTALS

A. Submit shop drawings, in accordance with requirements of all sections and provisions of these specifications.

1. For aerial crossings and water plant/facilities, include design of new pipe and fittings indicating alignment and grade, laying dimensions, lining and coating systems, proposed welding procedures, fabrication, fitting, flange, and special details. Show station numbers for pipe and fittings corresponding to Drawings.

2. Production of pipe and fittings prior to review by the Owner Representative shall be at Contractor's risk.

3. Submit manufacturers certification that pipe is new and unused.

1.04 QUALITY CONTROL

A. Provide manufacturer's certifications that all pipe and fittings have been hydrostatically tested at factory in accordance with AWWA C200, Section 3.4.

B. Provide manufacturer's affidavits that polyurethane coatings, linings and tape coatings comply with applicable requirements of this section and that coatings were applied and allowed to cure at a temperature 5 degrees above the dew point.

C. Provide manufacturer's affidavits that mortar coatings and linings comply with applicable requirements of this section and that linings were applied and allowed to cure at a temperature above 32 degrees F.

D. Prior to work being started, provide proof of certification of qualification for all welders employed for type of work, procedures and positions involved. Qualifications shall be in accordance with AWWA C206.

PART 2 P R O D U C T S

2.01 STEEL PIPE

A. Provide steel pipe designed and manufactured in conformance with AWWA C200 and AWWA M11 except as modified herein. Steel shall be minimum of ASTM A 36, ASTM A570 Grade 36, ASTM A 53 Grade B, ASTM A135 Grade B, or ASTM A139 Grade B.

B. Minimum Allowable Steel-Wall Thickness: In accordance with following table for HS-20 live loads and depths of bury of up to 16 feet and AWWA C200 new uncoated welded steel.

GENERAL PURPOSE CARBON STEEL PIPE

Casing	Min. Wall		Approx. Wt. Per Lin.
Pipe Size	O.D.	Thick.	Ft. Unct'd.
8"	8.625"	0.219"	19.64
10"	10.750"	0.219"	24.60
12"	12.750"	0.219"	29.28
14"	14.000"	0.219"	32.00
16"	16.000"	0.219"	36.86
20"	20.000"	0.250"	52.73
24"	24.000"	0.250"	63.41
30"	30.000"	0.250"	79.43

CASING PIPE
(ENCASEMENT SLEEVES)

Casing	Min. Wall		Approx. Wt. Per Lin.
Pipe Size	O.D.	Thick.	Ft. Unct'd.
8"	8.625"	0.219"	19.64
10"	10.750"	0.219"	24.60
12"	12.750"	0.219"	29.28
14"	14.000"	0.219"	32.00
16"	16.000"	0.219"	36.86
20"	20.000"	0.250"	52.73
24"	24.000"	0.250"	63.41
30"	30.000"	0.250"	79.43

C. Provide pipe sections in lengths of no less than 20 feet except as required for special fittings or closure sections.

D. Fittings: Factory forged for sizes 4 inches through 24 inches; long radius bends; beveled ends for field butt welding; wall thickness: equal to or greater than pipe to which fittings is to be welded; unless otherwise shown on the drawings.

E. Joints:

1. Standard field joint for steel pipe: AWWA C206.

   a. Single-welded, lap joint.

   b. Double-welded, butt joint.

2. Provide mechanically coupled or flanged joints where required for valves and fittings, and as shown on Drawings. Flanges: AWWA C207, Class D; same diameter and drilling as Class 125 cast iron flanges ASA B16.1. Maintain electrically isolated flanged joints between steel and cast iron by using epoxy-coated bolts, nuts, washers and insulating type gasket unless otherwise approved by Owner Representative.

F. Make curves and bends by use of beveled joints unless otherwise indicated on Drawings. Contractor may submit details of other methods of providing curves and bends for consideration by the Owner Representative. If other methods are deemed satisfactory, install at no additional cost to Owner.

G. Provide shop coated and shop lined steel pipe with minimum of one coat of shop applied primer approved for use in potable water transmission on all exposed steel surfaces. Primer for tape coated steel pipe to be used for field-applied coatings shall have no less than 5 percent solids. Provide primer compatible with coating system and in accordance with coating manufacturer's recommendations.

H. Standard or Special Sections: Within 1/8 inch + of specified or theoretical lengths. Flanges: Square with pipe with bolt holes straddling both horizontal and vertical axis. Provide 1/2-inch gap between pipe ends where pipe is to be coupled with sleeve couplings.

2.02 EXTERNAL COATING SYSTEMS FOR BURIED STEEL PIPE

A. General: Supplied with either tape coatings or cement-mortar coatings as specified herein.

1. Tape Coating: AWWA C214; 80-mil shop-applied, Polyken YG-III, Tek-Rap Yard-Rap, or equal, except as modified herein. Components: primer, one 20-mil layer of inner-layer tape for corrosion protection and two 30-mil layers of outer-layer tape for mechanical protection. Primer: compatible with tape coating, supplied by coating-system manufacturer. Provide pipe with shop coatings cut back from joint ends to facilitate joining and welding of pipe. Taper successive tape layers by 1-inch staggers to facilitate field wrapping of joints. Cutback approximately 4 to 4-1/2 inches to facilitate welding. Inner and outer tape widths:

Diameter	Tape Width
4″ – 6″	6″
8″ – 12″	9″
14″ – 16″	12″
18″ – 24″	18″

2. Cement-Mortar Coating: AWWA C205; shop-applied, cement-mortar coating except as modified herein; 1-inch minimum thickness; cut back coating from joint ends no more than 2 inches to facilitate joining and welding of pipe.

2.03 EXTERNAL COATING SYSTEM FOR STEEL PIPE IN TUNNEL, CASING OR AUGER HOLES

A. Provide exterior coating system of pipe in augered holes or casing, without annular grout, as specified in Section 02629, Polyurethane Coatings on Steel or Ductile Iron Pipe. No additional exterior coating is required for mortar coated pipe.

2.04 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND (OR EXPOSED)

A. Provide a 3-coat epoxy/polyurethane coating system as designated below.

Surface Preparation	SSPC SP10 Near White Blast Clean 2.0 to 3.0 mils surface profile
Prime Coat	2.0 to 4.0 mils DFT
Intermediate Coat	4.0 to 6.0 mils DFT
Finish Coat	1.5 to 2.0 mils DFT

B. Total minimum allowable dry film thickness for system: 10 mils.

C. All materials shall be from same manufacturer.

2.05 INTERNAL LINING SYSTEMS FOR STEEL PIPE

A. General: Supply steel pipe with either epoxy lining or shop applied cement mortar lining, capable of conveying water at temperatures not greater than 140EF. All linings shall conform to American National Standards Institute/National Sanitation

Foundation (ANSI/NFS) Standard 61 and certified by an organization accredited by ANSI. Unless otherwise noted, coat all exposed (wetted) steel parts of flanges, blind flanges, bolts, access manhole covers, etc., with epoxy lining, as specified herein.

B. Epoxy Lining: AWWA C210-92 - White, or approved equal for shop and field joint applied, except as modified herein.

1. Surface Preparation: SSPC-SP-10(64); Near White Blast Clean; 2.0 to 3.0 mils surface profile.

2. Prime Coat:

3. Intermediate Coat:

4. Finish Coat:

5. Minimum allowable dry film system thickness: 12.0 mils.

6. Maximum allowable dry film system thickness: 18.0 mils.

7. Minimum field adhesion: 700 psi.

8. Dry film thicknesses for approved alternate products in accordance with the product manufacturer's recommendations.

9. The lining system may consist of three or more coats of the same approved alternate epoxy lining without the use of a separate primer.

10. Provide materials from the same manufacturer.

C. Shop Applied Cement Mortar Lining: AWWA C205; shop-applied cement mortar linings, except as specified herein 3/8 inch minimum thickness for pipe diameters 24 inches and smaller. Pipe with cut back lining from joint ends no more than 2 inches to facilitate joining and welding of pipe.

2.06 MORTAR FOR EXTERIOR JOINTS

A. Cement Mortar: One part cement to two parts of fine, sharp clean sand; mix with water to a consistency of thick cream.

B. Portland cement: ASTM C150, Type II.

C. Sand:

1. Inside joints: AWWA C602; fine graded natural sand.

2. Outside joints: ASTM C33; natural sand with 100 percent passing No. 16 sieve.

D. Water: ASTM D1888, Method A; total dissolved solids less than 1000 mg/l; ASTM D512 chloride ions less than 100 mg/l for slurry and mortar cure; ASTM D1293 pH greater than 6.5.

PART 3 E X E C U T I O N

3.01 PIPING INSTALLATION

A. Conform to applicable provisions of Section 02664 - Water Mains except as modified herein.

3.02 EXTERNAL COATING SYSTEM FOR BURIED STEEL PIPE

A. Tape Coating System:

1. Inspect pipe, prior to shipment, for holidays and damage to coating. Perform electrical holiday test of minimum of 6,000 volts with a 60 cycle current audio detector. If test indicates no holidays and outer wrap(s) is torn, remove damaged layers of outer wrap by carefully cutting with sharp razor-type utility knife. Wash with Xylol area to be patched and at least 4 inches of undamaged tape where hand-applied tape wrap will overlap. AWWA C209 cold-applied tape; compatible with tape-wrapping system applied for each layer of outer-wrap tape that has been removed. If damaged area shows holiday when tested, remove outer layers and expose inner wrap. Prime exposed area and overlaps with light coat of primer. Firmly press into place patch of inner wrap of sufficient size to extend 4 inches from holidays in all directions. Holiday test patch to verify that it is installed satisfactorily. Retrim outer layer of tape to expose first wrap of outer-wrap tape sufficiently to allow minimum lap of 2 inches in all directions. Wash exposed outer wrap tape with Xylol and prime. Apply two layers of AWWA C209 outer wrap with 35 mils minimum thickness.

2. Regardless of results of electrical holiday test, bubbles in tape coating system are not allowed. Cut out bubbles and patch as detailed above.

3. Field repairs and applications of coatings: AWWA C209 around joint cutbacks except as modified herein. Field-welded joints: clean shop-primed ends of weld splatter, damaged primer and rust to achieve required surface preparation prior to field repair of linings and coatings.

a. Immediately prior to placing joint in trench, remove shop-applied primer by abrasive blasting, solvent or other method as approved by the Owner Representative. Avoid damage to adjacent existing coatings. Clean surfaces to achieve surface preparation at least equivalent to SSPC SP6 in accordance with AWWA C209. Solvent: environmentally safe and compatible with coating-system primer.

b. Apply primer immediately prior to application of first layer of tape to achieve maximum bond. Apply tape while primer is still "tacky" with 3-inch minimum overlap over shop-applied coating.

4. Do not expose tape coatings to harmful ultraviolet light for more than 90 days. Discard (remove) and replace outer layer of tape coating when exposure exceeds 90 days. In case of factory applied coatings, remove joint from site for removal and reapplication of outer layer of tape coatings.

B. At Owner's option, coating system and application may be tested and inspected at plant site in accordance with AWWA C214.

C. Cement Mortar Coating: AWWA C205; 1-inch minimum thickness; cut back from joint ends no more than 2 inches to facilitate joining and welding of pipe.

3.03 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND, IN VAULTS, TUNNELS OR CASINGS, AND INTERNAL LINING FOR ALL INSTALLATIONS

A. Cement Mortar Lining: AWWA C205; 1/2-inch minimum thickness; cut back from joint ends to facilitate joining and welding of pipe.

B. Safety: Paints, coatings, and linings specified herein are hazardous materials. Vapors may be toxic or explosive. Protective equipment, approved by appropriate regulatory agency, is mandatory for all personnel involved in painting, coating, and lining operations.

C. Workmanship:

1. Application: By qualified and experienced workers who are knowledgeable in surface preparation and application of high-performance industrial coatings.

2. Paint Application Procedures: SSPC Good Painting Practices, Volume 1.

D. Surface Preparation:

1. Prepare all surfaces for painting with abrasive blasting.

2. Schedule cleaning and painting so that detrimental amounts of dust or other contaminants do not fall on wet, newly painted surfaces. Protect surfaces not intended to be painted from effects of cleaning and painting operations.

3. Prior to blasting, clean surfaces to be coated or lined of grease, oil and dirt by steaming or detergent cleaning in accordance with SSPC SP1.

4. Metal and Weld Preparation: Remove all surface defects such as gouges, pits, welding and torch-cut slag, welding flux and spatter by grinding to 1/4-inch minimum radius.

5. Abrasive Material:

   a. Blast only as much steel as can be coated same day of blasting.

   b. Use sharp, angular, properly graded abrasive capable of producing depth of profile specified herein. Transport abrasive to jobsite in moisture-proof bags or airtight bulk containers. Copper slag abrasives are not acceptable.

   c. After abrasive blast cleaning, verify surface profile with replica tape. Furnish tapes to Owner for filing and future reference.

   d. Do not blast if metal surface may become wet before priming commences, or when metal surface is less than 5 degrees F above dew point.

6. Remove all dust and abrasive residue from freshly blasted surfaces by brushing or blowing with clean, dry air.

E. Coating and Lining Application:

1. Environmental Conditions: Do not apply coatings or linings when metal temperature is less than 50 degrees F; when ambient temperature is less than 5 degrees F above dew point; when expected weather conditions are such that ambient temperature will drop below 40 degrees F within 6 hours after application of coating; or when relative humidity is above 85 percent. Measure relative humidity and dew point by use of sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. Provide dehumidifiers for all field-applied coatings and linings to maintain proper humidity levels.

2. Application Procedures:

a. Apply coatings and linings in accordance with manufacturer's recommendations and requirements of this section. Provide a finish free of runs, sags, curtains, pinholes, orange peel, fish eyes, excessive overspray or delamination.

b. Thin materials only with manufacturer's recommended thinners. Thin only amount required to adjust viscosity for temperature variations, proper atomization and flow-out. Mix material components using mechanical mixers.

c. Discard catalyzed materials remaining at end of day.

3. Apply primer immediately after surface has been cleaned. Thoroughly dry pipe before primer is applied. Apply succeeding coats before contamination of under surface occurs.

4. Allow each coat of paint either to dry or cure amount of time recommended by coating or lining manufacturer before successive coats of paint are applied. Apply all successive coats of paint within recoat threshold time as recommended by coating or lining manufacturer on printed technical data sheets or through written communications.

3.04 INSPECTION

A. Procure services of an independent testing laboratory or inspection service, approved by the Owner Representative, to perform tests on all portions of coating and lining applications. Laboratory shall supply services of NACE Certified Coatings Inspectors having Level III Certification for all coating and linings inspection work. Include cost of such testing in contract unit price bid for water main. Furnish copies of all test reports to the Owner Representative for review. If defective coatings or lining are revealed, cost of repair and testing of repair will be paid for by Contractor. The Owner Representative shall have full and final decision as to suitability of all coatings and linings tested.

B. For all field applied coatings and linings, including joints, notify Owner sufficiently in advance of work so that Owner can perform examination of and acceptance of surface preparation and application of each coat prior to application of next coat. Furnish appropriate test data to Owner verifying compliance with requirements of this section of each coat prior to proceeding with next coat. Recoat or repair runs, overspray, roughness and/or abrasives in coating, or other indications of improper application in accordance with coating or lining manufacturer's and the Owner Representative's instructions.

C. Repairs, surface preparation and painting will be subject to inspection by Owner. Guidelines published by Steel Structures Painting Council will be used as basis for acceptance or rejection of cleaning, painting or coating application. SSPC VIS1, Pictoral Surface, along with single-probe magnetic pull-off type dry film thickness gages, electrical holiday detectors, and standard wet film thickness gages will be used to determine acceptability of paint applications.

D. Check film thickness with nondestructive magnetic pull-off gage such as Mikrotest Model DFG-100 or electronic thickness gage. National Bureau of Standards certified thickness calibration plates will be used to verify accuracy of thickness gage. Determine maximum and minimum thickness in accordance with SSPC PA2 for frequency and method. Evaluate each length of pipe under SSPC PA2. Consider each field joint area separate and discrete for purpose of DFT measurements. Perform five spot DFT measurements on each field joint area (15 individual readings). Check thickness of each individual coat as well as thickness of overall system with respect to compliance with this Section. Failure to meet either overall system thickness requirements or requirements of component coats shall be cause for rejection and recoat or repair of entire joint or length of pipe.

E. Holiday Test:

1. Begin inspection after coating has sufficiently cured, usually one to five days. (Consult coating manufacturer for specific curing schedule.)

2. Use high-voltage d-c holiday detector such as D.E. Stearns Company Model 14/20 or Tinker & Rasor Model AP/W. Use 1600 volts, plus or minus 100 volts. Use brass brush type electrode.

3. Ground high-voltage d-c holiday detector to metal being inspected. Earth-type ground tape is not acceptable. Mark detected defects with white chalk, repair and reinspect.

4. Adhesion Tests: ASTM D4541; pull-off testing using an Elcometer Model 106 Fixed Alignment Adhesion Tester. Adhesion testing may be directed by the Owner's Representative on any length of pipe or joint which exceeds maximum coating thickness limitations specified in this Section.

3.05 COATINGS AND LININGS INSPECTION

A. Owner reserves right to inspect or acquire service of independent third-party inspector who is fully knowledgeable of, and qualified to inspect, surface preparation and application of high-performance coatings to inspect any and all phases of all coatings and linings work, whether field or shop applied. Contractor responsible for

application and performance of coating and lining whether or not Owner provides such inspection.

END OF SECTION

SECTION 02615

REINFORCED CONCRETE PIPE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Reinforced concrete pipe for storm sewers.

1.02 UNIT PRICES

A. No separate payment will be made for reinforced concrete pipe under this Section. Include payment in unit price for Sections 02720 - Storm Sewers.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit complete product data for pipe, fittings and gaskets for approval. Indicate conformance to appropriate reference standards.

C. Submit certificates by a testing laboratory, hired and paid by the manufacturer, that concrete pipes meet applicable standards when tested in accordance with ASTM C497.

PART 2 P R O D U C T S

2.01 REINFORCED CONCRETE PIPE

A. Circular reinforced concrete pipe shall conform to requirements of ASTM C76, for Class III wall thickness. Joints shall be rubber gasketed conforming to ASTM C443.

B. Reinforced concrete arch pipe shall conform to the requirements of ASTM C506 for Class A-III. Joints shall conform to ASTM C877.

C. Reinforced concrete elliptical pipe, either vertical or horizontal, shall conform to the requirements of ASTM C507 for Class VE-III for vertical or Class HE-III for horizontal. Joints shall be rubber gaskets conforming to ASTM C877.

D. Reinforced concrete D-load pipe shall conform to the requirements of ASTM C655.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Conform to requirements of Sections 02720 - Storm Sewers.

B. Install reinforced concrete pipe in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 02620

PVC PIPE

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. Polyvinyl chloride pressure pipe for water distribution in nominal diameters 4 inches through 16 inches.

B. Polyvinyl chloride sewer pipe for gravity sanitary sewers in nominal diameters 4 inches through 48 inches.

C. Polyvinyl chloride pressure pipe for gravity sanitary sewers and force mains in nominal diameters 4 inches through 36 inches.

1.02 UNIT PRICES

A. No separate payment will be made for PVC pipe under this section. Include cost in unit price for water mains, gravity sanitary sewer, and force mains.

1.03 SUBMITTALS

A. Conform to requirements of all provisions and sections of these specifications.

B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

1.04 QUALITY CONTROL

A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900 or AWWA C 905 for pressure pipe applications, or the appropriate ASTM standard specified for gravity sewer pipe.

B. Submit manufacturer's certification that PVC pressure pipe has been hydrostatically tested at the factory in accordance with AWWA C 900 or AWWA C 905 and this Section.

PART 2 - P R O D U C T S

2.01 MATERIAL

A. Use PVC compounds in the manufacture of pipe that contain no ingredient in an amount that has been demonstrated to migrate into water in quantities considered to be toxic.

B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for a rating of 4000 psi for water at 73.4 degrees F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.

C. For PVC pressure pipe used for water mains, provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.

D. Gaskets:

1. Gaskets shall meet the requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.

2. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed sewer, shall have the following gasket materials for the noted contaminants.

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other Contaminants	As recommended by the pipe manufacturer

E. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.

2.02 WATER SERVICE PIPE

A. Pipe 4-inch through 12-inch: AWWA C 900, Class 150, DR 18; nominal 20-foot lengths; cast iron equivalent outside diameters.

B. Pipe 16-inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast iron equivalent outside diameter.

C. Joints: ASTM D 3139; push-on type joints in integral bell or separate sleeve couplings. Do not use socket type or solvent weld type joints.

D. Make curves and bends by deflecting the joints. Do not exceed maximum deflection recommended by the pipe manufacturer. Submit details of other methods of providing curves and bends for review by the Owner Representative.

E. Hydrostatic Test: AWWA C 900, AWWA C 905, ANSI A21.10 (AWWA C110); at point of manufacture; submit manufacturer's written certification.

2.03 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

A. Bends and Fittings: ANSI A21.10, ductile iron; ANSI A21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating.

B. Coatings and Linings: Conform to requirements of Section 02610 - Ductile-Iron Pipe and Fittings.

C. Restraints for large diameter PVC pipe (AWWA C905) at the bell shall be consist of the following:

1. The restraint shall be manufactured of ductile iron conforming to ASTM A536.

2. A backup ring shall be utilized behind the PVC bell.

3. A restraint ring, incorporating a plurality or individually actuating gripping surfaces, shall used to connect the bell ring and gripping ring.

4. The restraint shall be the Series 2800 as manufactured by EBAA Iron, Inc., or approved equal.

2.04 GRAVITY SANITARY SEWER PIPE

A. PVC gravity sanitary sewer pipe shall be in accordance with the provisions in the following table:

WALL CONSTRUCTION	MANUFACTURER	PRODUCT OPTIONS	ASTM DESIGNATION	SDR (Max.)/ STIFFNESS	DIAMETER SIZE RANGE
Solid	J-M Manufacturing Co, Inc.	Approved	D3034	SDR 26 / PS 115	6" to 15"
	CertainTeed	Approved	F679 (T-1)	SDR 26 / PS 115	18" to 24"
	Can-Tex				
	Carlon Company	Approved	F679 (T-1)	SDR 35 / PS 46	27" to 36"
	Diamond Plastics Corp				
	North American Pipe Corporation (NAPCO)	Approved	AWWA C900	DR 18 / N/A	4" to 12"
		Approved	AWWA C905	DR 18 / N/A	14" to 36"

B. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.

C. For sewers up to 12-inch-diameter crossing over waterlines, or crossing under waterlines with less than 2 feet separation, provide minimum 150 psi pressure-rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.

D. Joints: Spigot and integral wall section bell with solid cross section elastometric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477, shall be provided. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. The manufacturer shall test a sample from each batch conforming to requirements ASTM D2444.

E. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.

2.05 SANITARY SEWER FORCE MAIN PIPE

A. Provide PVC pressure pipe conforming to the requirements for water service pipe, and conforming to the minimum working pressure rating specified in Section 02731 - Sanitary Sewage Force Mains.

B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting the requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use EBAA Iron Series 2000PV, Uniflange Series 1350 restrainer, or equal joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.

C. Fittings: Provide ductile iron fittings as per Paragraph 2.03, except furnish all fittings with one of the following internal linings:

1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to the interior surface of the fitting, as manufactured by American Cast Iron Pipe "Polybond", or U.S. Pipe "Polyline".

2. Nominal 40 mils (35 mils minimum) polyurethane, Corro-pipe II by Madison Chemicals, Inc.

3. Nominal 40 mils (35 mils minimum) ceramic epoxy, Protecto 401 by Enduron Protective Coatings.

D. Exterior Protection: Provide polyethylene wrapping of ductile iron fittings as required by Section 02630 - Polyethylene Wrap.

E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02 E.

PART 3 - E X E C U T I O N

3.01 PROTECTION

A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with the manufacturer's recommendations.

B. Contractor is responsible for proper storage and protection of stored pipe.

3.02 INSTALLATION

A. Conform to requirements of Section 02664 - Water Mains, Section 02730 - Gravity Sanitary Sewers, Section 02731 - Sanitary Sewage Force Mains, and Section 02763 - Point Repairs to Sanitary Sewers, as applicable.

B. Install PVC pipe in accordance with Section 02227 - Excavation and Backfill for Utilities, ASTM D 2321, and manufacturer's recommendations.

C. Water service pipe 12 inches in diameter and smaller: Installed to clear utility lines and have minimum 4 feet of cover below finished grade above the pipe, unless otherwise required by Drawings.

D. Avoid imposing strains that will overstress or buckle the pipe when lowering pipe into trench.

E. Hand shovel pipe bedding under the pipe haunches and along the sides of the pipe barrel and compact to eliminate voids and ensure side support.

END OF SECTION

SECTION 02626

TAPPING SLEEVES AND VALVES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Tapping sleeves and valves for connections to existing water system.

1.2 UNIT PRICES

A. Measurement is on a lump sum basis for each tap.

1.3 SUBMITTALS

A. Submit product data in accordance with requirements of all sections and provisions of these specifications.

1.4 QUALITY CONTROL

A. Provide manufacturer's affidavit that all valves purchased for tapping of existing waterlines conform to Section 02640 - Gate Valves and to applicable requirements of AWWA C500 and that they have been satisfactorily tested in accordance with AWWA C500.

PART 2 - P R O D U C T S

2.1 MATERIALS

A. Tapping Sleeves:

1. Tapping Sleeve Bodies: AWWA C110 cast or ductile iron; AWWA C200 carbon steel; in two sections to be bolted together with high-strength, corrosion-resistant, low-alloy, steel bolts; mechanical joint ends.

2. Branch Outlet of Tapping Sleeve: Flanged; machined recess; AWWA C207, Class D, ANSI 150 lb drilling. Gasket: Affixed around recess of tap opening to preclude rolling or binding during installation.

3. Where fire service from 6-inch main is approved, use cast iron split sleeve.

B. Welded-steel tapping-sleeve bodies may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions.

1. Flange: AWWA C207, Class D, ANSI 150 lb drilling. Gasket: Affixed around recess of tap opening to preclude rolling or binding during installation.

2. Steel sleeves are restricted to use on pipe sizes 6-inch and larger.

3. Body: Heavy, welded-steel construction; top half grooved to retain neoprene O-ring seal permanently against O.D. of pipe.

4. Bolts: AWWA C500 Section 3.5; coated with 100 percent vinyl resin or corrosive resistant material.

5. Steel Sleeves: Fusion-bonded epoxy coated to minimum 12-mil thickness. Finished epoxy coat: Free of laminations and blister; not peel; and remain pliant and resistant to impact. Ship steel sleeves in wooden crates that provide protection from damage to epoxy coating during transport and storage.

6. Steel tapping sleeves shall be Smith Blair No. 622, JCM No. 412, or equal.

7. Tapping Sleeves: Provide with 3/4-inch NPT test opening for testing prior to tapping. Provide 3/4-inch bronze plug for opening.

8. Do not use steel sleeves for taps greater than 75 percent of pipe diameter.

C. Tapping Valves: Meet all requirements of Section 02640 with following exceptions:

1. Inlet Flanges:

a. AWWA C110; Class 125.

b. AWWA C110; Class 150 and higher: Minimum eight hole flange.

2. Outlet: Standard mechanical or push-on joint; to fit any standard tapping machine.

3. Valve Seat Opening: Accommodate full-size shell cutter for nominal size tap without any contact with valve body; double disc.

D. Valve Boxes: Furnish and install according to Section 02604.

PART 3 - E X E C U T I O N

3.1 GENERAL

A. Install tapping sleeves and valves at locations and of sizes as shown on Drawings.

B. Thoroughly clean tapping sleeve, tapping valve and pipe prior to installation and in accordance with manufacturer's instructions.

C. Hydrostatically test installed tapping sleeve to 150 psig for a minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.

D. When tapping concrete pressure pipe, size on size, use shell cutter one standard size smaller than waterline being tapped.

E. Do not use Large End Bell (LEB) increasers with a next size tap unless existing pipe is asbestos-cement.

3.2 INSTALLATION

A. Tighten bolts in proper sequence so that undue stress is not placed on pipe.

B. Align tapping valve properly and attach it to tapping sleeve.

C. Make tap with sharp, shell cutter:

1. For 12-inch and smaller tap, use minimum cutter diameter one-half inch less than nominal tap size.

2. For 16-inch and larger tap, use manufacturer's recommended cutter diameter.

D. Withdraw coupon and flush all cuttings from newly made tap.

E. Wrap completed tapping sleeve and valve in accordance with Section 02630.

F. Place concrete thrust block behind tapping sleeve (NOT over tapping sleeve and valve).

G. Request inspection of installation prior to backfilling.

H. Backfill in accordance with Section 02227.

END OF SECTION

SECTION 02627

WATER METERS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Water meters for customer service, including submeters (i.e., cooling tower meters, sewer credit meters, etc.), for fire service in sizes 5/8 inch through 10 inches.

1.2 UNIT PRICES

A. Measurement for water meters is on a lump sum basis for installation of each meter type and size. Owner will furnish all water meters.

PART 2 - P R O D U C T S

2.1 GENERAL

A. Owner furnishes all water meters up to 2". Water meters are to be Orion meters from Badger Meter, Inc., Milwaukee, WI.

B. CONNECTIONS AND FITTINGS

1. Connections: Provide pipe in accordance with Section 02610 and Section 02620; restrained joints only.

2. Fittings: Restrained ductile iron; push-on bell joints or mechanical joint fittings outside of meter vault installations; Class 125 flanged inside meter vaults; cement mortar lined and sealed.

2.2 LAYING LENGTHS

A. The minimum length (with 1 inch tolerance) for meter and standard strainer shall be shown as indicated on the detail drawing for water meters.

PART 3 - E X E C U T I O N

3.1 TAPPING AND SERVICE LINE INSTALLATION

A. Refer to Section 02626 for tapping requirements.

B. Service Line:

1. Use pipe and fittings which conform to the requirements of Section 02610 - Ductile-Iron Pipe and Fittings, or Section 02620 - PVC Pipe.

2. Only pull or deflect joints to limits recommended by manufacturer.

3. Make vertical adjustments with offset bends where room will permit. Minimize number of bends.

4. Ten pipe diameters minimum of straight pipe length upstream and downstream of meter vault.

3.2 METER FITTING HOOKUP

A. Support meter piping; level and plumb meter during and after installation. Meters 3 inches and larger: support at minimum two locations with concrete.

B. Use round flanged fittings inside meter box or vault except for mechanical joint to flange adapter. Provide full-face 1/8-inch black neoprene or red rubber gasket material on flanged joints. Provide bolts and nuts made from approved corrosion-resistant material.

C. Tighten all bolts in proper sequence and to correct torque.

D. Visually check for leaks under normal operating pressure following installation. Repair or replace any leaking components.

END OF SECTION

SECTION 02629

POLYURETHANE COATINGS ON STEEL OR DUCTILE IRON PIPE

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Two-component polyurethane coating system for use as an internal or external coating for steel or ductile iron pipe.

1.2 UNIT PRICES

A. No separate payment will be made for work performed under this section. Include cost of polyurethane coatings in contract unit prices for steel pipe or ductile iron pipe.

1.3 SAFETY

A. Secure, from manufacturer, Material Safety Data Sheet (MSDS) for polyurethane coatings and repair materials listed in this section.

B. Safety requirements stated in this specification and in related sections apply in addition to applicable federal, state and local rules and regulations. Comply with instructions of coating manufacturer and requirements of insurance underwriters.

C. Adhere to handling and application practices of SSPC-PA Guide 3; SSPC-PS Guide 17.00; Coating Manufacturer's Material Safety Data Sheet.

1.4 SUBMITTALS

A. Submittals shall conform to requirements of all provisions and sections of these specifications.

B. Submit coating manufacturer's catalog sheets and technical information for approval, prior to delivery of pipe.

C. Obtain from coating manufacturer and furnish to Owner’s Representative, a coating "affidavit of compliance" to requirements of this section stating that coatings were applied in factory and in accordance with manufacturer's minimum requirements.

PART 2 - P R O D U C T S

2.1 COATING MATERIAL

A. Coating Standard: ASTM D16.

B. Coating System: Use a Coating Standard ASTM D16 Type, V system which is a 2-package polyisocyanate, polyol-cured urethane coating. The components are mixed in 1:1 ratio at time of application. The components are balanced viscosities in their liquid state and do not require agitation during use.

C. Exterior Coating Material: CORROPIPE II-TX and Joint Coating Material CORROPIPE II-PW, as manufactured by Madison Chemical Industries, Inc., or approved equal.

D. Internal Coating Material: Exterior Coating Material, CORROPIPE II-TX and Joint Coating Material CORROPIPE II-PW, as manufactured by Madison Chemical Industries, Inc., or approved equal.

E. Cured Coating Properties:

1. Conversion to Solids by Volume: 97 percent plus or minus 3 percent.

2. Temperature Resistance: Minus 40 degrees F and plus 130 degrees F.

3. Minimum Adhesion: 500 psi, when applied without primer to ductile iron pipe which has been blasted to comply with SSPC-SP10.

4. Cure Time: For handling in 1 minute at 120 degrees F, and full cure within 7 days at 70 degrees F.

5. Maximum Specific Gravities: Polyisocyanate resin, 1.20. Polyol resin, 1.15.

6. Minimum Impact Resistance: 80 inch-pounds using 1-inch diameter steel ball where coating is applied at 30 mils to ductile iron pipe surface which has been blasted to SSPC No. 10 finish.

7. Minimum Tensile Strength: 2000 psi.

8. Hardness: 55 plus or minus 5 Shore D at 70 degrees F.

9. Flexibility Resistance: ASTM D1737 using 1-inch mandrel. Allow coating to cure for 7 days. Perform testing on test coupons held for 15 minutes at temperature extremes specified in Paragraph 2.01E.

2.2 REPAIR AND/OR TOUCHUP MATERIAL

A. CORROPIPE II PW - TOUCHUP (two-component, brush applied); mix in accordance with coating manufacturer's recommendations.

2.3 PACKAGING AND LABELING

A. Containers: Standard containers to prevent gelling, thickening deleteriously or forming of gas in closed containers within period of one year from date of manufacture.

B. Labeling: Label each container of separately packaged component clearly and durably to indicate date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name or formula specification number of coating together with special instructions. Do not use coating components older than one year.

2.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver coating materials to pipe manufacturer in sealed containers showing designated name, batch number, color, date of manufacture and name of coating manufacturer.

B. Storage: Store material on site in enclosures, out of direct sunlight in warm, ventilated and dry area.

C. Protection: Prevent puncture, inappropriate opening or other action which may lead to product contamination.

PART 3 - E X E C U T I O N

3.1 SURFACE PREPARATION

1. Remove deposits of oil, grease or other organic contaminates before blast cleaning by using solvent wash as specified in SSPC-SP1. Clean and dry surfaces making them completely dry, free of moisture, dust, grit, oil, grease or any other deleterious substances prior to application of coating.

2. Exterior and Interior Surfaces: SSPC-SP10; near-white metal blast cleaning. The blasting shall be done with clean, hard, sharp cutting abrasives with no steel or cast iron shot in the mix.

3. Ductile Iron Pipe: Prior to the start of production blasting, the Contractor shall prepare specimens for a white metal blast and a near-white metal blast using the equipment and abrasives proposed for the work. During preparation of the specimens, the blasting intensity and abrasive shall be changed as necessary to provide the degree of cleaning required by SSPC-SP10, except that the color of the blasted substrate is not expected to match the color of blasted steel. After examination and concurrence by the Owner's Representative, the production blasting may begin. The production blasting shall be monitored and controlled by the Contractor so that production pipe surfaces match the surface of the approved blasting specimens.

3.2 THICKNESS

A. External Coatings: Minimum DFT of 25 mils (0.025 inch).

B. Internal Coatings: Minimum DFT of 35 mils.

C. Thickness Determinations: Use Type 1 magnetic thickness gage as described in SSPC-PA2 specification. Individual readings below 90 percent of specified minimum are not acceptable. Average individual spot readings (consisting of three point measurements within 3 inches of each other) less than 95 percent of minimum are not acceptable. Average of all spot readings less than minimum thickness specified are not acceptable.

3.3 FACTORY APPLICATION OF POLYURETHANE COATING

A. Equipment: Two-component, 1:1 mix ratio, heated airless spray unit.

B. Temperature: Minimum 5 degrees F above dew point temperature. The temperature of the surface shall not be less than 60 degrees F during application.

C. Humidity: Heating of pipe surfaces may be required to meet requirements of 2.01E if relative humidity exceeds 80 percent.

D. Do not thin or mix resins; use as received. Store resins at a temperature above 55 degrees F at all times.

E. Application: Conform to coating manufacturer's recommendations. Apply directly to substrate to achieve specified thickness. Multiple-pass, one-coat application process is permitted provided maximum allowable recoat time specified by coating manufacturer is not exceeded.

F. Recoating: Recoat only when coating has cured less than maximum time specified by coating manufacturer. When coating has cured for more than recoat time, brush-blast or thoroughly sand coating surface. Blow-off cleaning using clean, dry, high-pressure compressed air.

G. Curing: At ambient temperature above 0 degrees F. Do not handle pipe until coating has been allowed to cure as follows:

Ambient Temperature	Minimum Full Cure Time
Over 70˚F	7 days
50 to 70˚F	9 days
0 to 50˚F	12 days

3.4 JOINTS

A. Apply coating to unlined pipe surfaces including inside of bell socket and outside of spigot.

B. Joint Coating Materials: CORROPIPE II PW (instant-set, two-component material, plural component spray applied), or CORROPIPE II PW -TOUCHUP (two-component, brush applied).

C. Coating thickness on sealing areas of spigot end of pipe exterior: Minimum 8 mils (0.008 inch), maximum of 10 mils (0.010 inch). Maximum 10 mils may be exceeded in spigot end provided maximum spigot diameter as specified by pipe manufacturer is not exceeded.

3.5 INSPECTION

A. Owner’s Representative may inspect coatings at coating applicator's facilities.

B. Holiday Inspection: AWWA C210, Section 5.3.3.1. Follow coating manufacturer's recommendation. Conduct inspection any time after coating has reached initial cure. Repair in accordance with paragraph 3.07, Repair and Field Touchup.

3.6 PIPE INSTALLATION

A. For wastewater projects, provide services of manufacturer's representative for period of not less than 2 weeks at beginning of actual pipe laying operations to advise Contractor regarding installation including but not limited to handling and storing, cleaning and inspecting, coatings repairs, and general construction methods as to how they may affect pipe coatings.

B. Handling, Shipment, and Storage: Nylon straps, padded lifts and padded storage skids are required. Field cuts should be kept to minimum. Repair damage to coating due to handling or construction practices at no additional cost to. See Section 02610 - Ductile Iron Pipe and Fittings and Section 02611 - Steel Pipe and Fittings for additional requirements.

C. Just before each section of pipe is to be placed into the trench, conduct a visual and holiday inspection. Defects in the coating system shall be repaired before the pipe is installed.

3.7 REPAIR AND FIELD TOUCHUP

A. Apply repair/touchup materials in conformance with factory application of polyurethane coating requirements specified in this section, excluding equipment requirements.

B. Repair Procedure - Holidays:

1. Remove all traces of oil, grease, dust, dirt, etc.

2. Roughen area to be patched by sanding with rough grade sandpaper (40 grit).

3. Apply one coat of repair material described above. Work repair material into scratched surface by brushing.

C. Repair Procedure - Field Cuts or Large Damage:

1. Remove burrs from field cut ends or handling damage and smooth out edge of polyurethane coating.

2. Remove all traces of oil, grease, dust, dirt, etc.

3. Roughen area to be patched with rough grade sandpaper (40 grit). Feather edges and include overlap of 1 inch to 2 inches of roughened polyurethane in area to be patched.

4. Apply thick coat of repair material described above. Work repair material into scratched surface by brushing. Feather edges of repair material into prepared surface. Cover at least 1 inch of roughened area surrounding damage, or adjacent to field cut.

D. For Wastewater Projects; Repair Procedure - Thermite Brazed Connection Bonds:

1. Remove polyurethane coating from area on metal surface which is to receive thermite brazed connection with power wire brush.

2. Grind metal surface to shiny metal with power grinder and coarse grit grinding wheel.

3. Apply thermite brazed connection using equipment, charge and procedure recommended by manufacturer of thermite equipment.

4. After welded surface has cooled to temperature below 130 F, apply protective coating repair material to weld, exposed pipe surface and damaged areas of polyurethane coating.

5. Do not cover or backfill freshly repaired areas of coating at thermite brazed connection until repair material has completely cured. Allow material to cure in conformance with manufacturer's recommendations.

END OF SECTION

SECTION 02642

AIR RELEASE AND VACUUM RELIEF VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Air release and vacuum relief valves.

1.02 UNIT PRICES

A. Measurement is on a lump sum basis for each valve installed.

B. Payment includes air release valve manholes and fittings and appurtenances necessary for complete installation of valve. The Owner's Representative may request a detailed schedule of values for more complex installations.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all provisions and sections of these specifications.

B. Submit manufacturer's product data for proposed valves for approval.

1.04 QUALITY CONTROL

A. Provide manufacturer's affidavit that air release and vacuum relief valves purchased for Work, were manufactured and tested in the United States, and conform to applicable requirements of this Section.

PART 2 P R O D U C T S

2.01 GENERAL

A. Combination air valve called for on Drawings means combination valve designed to fulfill functions of air release (permit escape of air accumulated in line at high point of elevation while line is under pressure) and vacuum relief. Air release and vacuum relief valves 8 inches and smaller in diameter shall be self-contained in one unit.

2.02 MATERIALS

A. Air Release Valves: Apco No. 200, GA Industries Fig. 2-AR, or equal. Materials: body and cover, ASTM A48, Class 30, cast iron; float and leverage mechanism, ASTM A240 or A276 stainless steel; orifice and seat, stainless steel against Buna-N

or Viton mechanically retained with hex head nut and bolt; other valve internals, stainless steel or bronze. Provide inlet and outlet connections, and orifice as shown on Drawings.

B. Air Release and Vacuum Valves: Provide single-body, standard combination or duplex-body custom combination valves as indicated on Drawings.

1. For 2-inch and 3-inch, single-body valves, provide inlet and outlet sizes as shown on Drawings and orifice sized for 100 psi working pressure. Valve materials: body, cover and baffle, ASTM A48, Class 35, or ASTM A126, Grade B cast iron; plug or poppet, ASTM A276 stainless steel; float, ASTM A240 stainless steel; seat, Buna-N; other valve internals, stainless steel. Valve exterior: Painted with shop-applied primer suitable for contact with potable water. Provide Apco Model 145C or 147C, Val-Matic Series 200, or equal valves.

2. For 3-inch and larger duplex body valves as shown on Drawings, provide Apco Series 1700 with No. 200 air release valve, GA Industries Fig. No. AR/GH-21K/280, or equal. Air and vacuum valve materials: body and cover, ASTM A48, Class 35, cast iron; float, ASTM A240 stainless steel; seat, Type-304, stainless steel and Buna-N; other valve internals, stainless steel or bronze. Air release valve: Constructed as specified in paragraph above on Air Release Valves.

C. Vacuum Relief Valves: Provide air inlet vacuum relief valves with flanged inlet and outlet connections as shown on Drawings. Provide air release valves in combination with inlet and outlet, and orifice as shown on Drawings. Valve shall open under pressure differential not to exceed 0.25 psi. Provide Apco Series 1500 with a No. 200A air release valve, GA Industries Fig. No. HCARV, or equal. Materials for vacuum relief valves: valve body, ASTM A48, Class 35, cast iron; seat and plug, ASTM B584 bronze, copper alloy 836; spring, ASTM A313, Type-304, stainless steel; bushing, ASTM B584 bronze, copper alloy 932; retaining screws, ASTM A276, Type-304, stainless steel.

D. Air Release Valve Vault as detailed in Drawings.

PART 3 E X E C U T I O N

3.01 EARTHWORK

A. Conform to applicable provisions of Section 02227.

3.02 SETTING VALVES AND VALVE BOXES

A. Provide services of technical representative of valve manufacturer available on site during installation of valves.

B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that all parts are in satisfactory working condition.

C. Install valves and valve boxes where indicated on Drawings or as located by the Owner's Representative. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face if less than 4 feet. Provide above-ground vents for valve boxes as indicated on drawings.

3.03 DISINFECTION AND TESTING

A. Disinfect valves and appurtenances as required by Section 02675 and test as required by Section 02676.

3.04 PAINTING OF PIPING

A. Paint valves located in vaults, stations, and aboveground using ACRO Paint No. 2215, "Galveston Blue" or approved equal, unless otherwise directed by the Owner's Representative.

END OF SECTION

SECTION 02643

PRESSURE REDUCING VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Pressure reducing valves (PRV).

1.02 UNIT PRICES

A. Measurement is on a lump sum basis for each valve installed.

B. Payment includes valve boxes and necessary fittings and appurtenances necessary for complete installation of valve. The Owner’s Representative may request a detailed schedule of values for more complex installations.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all provisions and sections of these specifications.

B. Submit manufacturer's product data for proposed valves for approval.

1.04 QUALITY CONTROL

A. Provide manufacturer's affidavit that pressure-reducing valves purchased for Work, were manufactured and tested in the United States, and conform to applicable requirements of this Section.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Provide Cla-Val Model 90-01, or equal, PRV with strainer in location and arrangement as shown on Drawings. Valve body: ASTM A48, cast iron or ASTM A126, Class B, cast iron with ANSI B16.1, Class 125, flanges. Valve cover: ASTM A48 cast iron. Valve internals: Type-303, stainless steel or B-62 bronze. Rubber parts: Buna-N. No leather parts shall be allowed. Resilient seat shall have rectangular cross section.

B. Control Tubing: Contain shutoff cocks with "Y" strainer.

C. PRV: Equip with valve position indicator. Initially set in field by authorized manufacturer's representative with 60 psi downstream pressure.

D. Provide basket strainer upstream of PRV as shown on Drawings. Strainer body: quick-opening type, fabricated-steel construction with ANSI B16.1, Class 150, flanges. Basket: Type-304, stainless steel. Provide Hayward Model 90, or equal, for PRV 4-inch through 24-inch. Provide Hayward Model 510, or equal, for PRV 14 inches or greater when space limitations dictate the use of smaller strainer housing.

E. Pilot Systems for PRV: Adjustable and pressure sustaining.

F. Valve Box: Valve Box conforming to requirements of Section 02604.

PART 3 E X E C U T I O N

3.01 EARTHWORK

A. Conform to applicable provisions of Section 02227.

3.02 SETTING VALVES AND VALVE BOXES

A. Provide services of technical representative of valve manufacturer available on site during installation of valves and to advise on aspects of installation.

B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that all parts are in satisfactory working condition.

3.03 DISINFECTION AND TESTING

A. Disinfect valves and appurtenances as required by Section 02675 and test as required by Section 02676.

3.04 PAINTING OF PIPING

A. Paint valves located in vaults, stations, and aboveground using ACRO Paint No. 2215, “Galveston Blue” or approved equal, unless otherwise directed by Owner’s Representative.

END OF SECTION

SECTION 02676

HYDROSTATIC TESTING OF PIPELINES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Field hydrostatic testing of new water pipelines.

1.02 UNIT PRICES

A. No payment will be made for hydrostatic testing of pipelines under this Section. Include cost in unit price of pipelines being tested.

PART 2 P R O D U C T S - NOT USED.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Hydrostatically test all new water pipelines for liquids after disinfection, if required, and before connecting to water distribution system.

B. Pipelines shall be tested in lengths between valves, or plugs, of not more than 1,000 feet unless greater length is approved by Owner's Representative.

C. C. Conduct hydrostatic tests in presence of Owner's Representative in accordance with requirements of this Section.

3.02 PREPARATION

A. Disinfect water system pipelines prior to hydrostatic testing.

3.03 TEST PROCEDURES

A. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.

B. Allow pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Contractor should be aware that periods of up to 7 days may be required for mortar lining to become saturated.

C. Expel all air and apply a minimum test pressure of 150 psi as directed by Owner's Representative

D. Maintain test pressure for 4 hours. If a large quantity of water is required to maintain pressure during test, testing shall be discontinued until cause of water loss is identified and corrected.

3.04 ALLOWABLE LEAKAGE FOR WATER MAINS

A. During hydrostatic tests, no leakage will be allowed for sections of water mains consisting of welded joints.

B. Maximum allowable leakage for water mains with rubber gasketed joints shall be as determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{133{,}200}$$

C. Allowable Leakage per 1000 feet of Pipeline in GAL/HR at 150 psi:

3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"
0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98

3.05 CORRECTION FOR FAILED TESTS

A. Repair all joints showing visible leaks on surface regardless of total leakage shown on test. Check all valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove any cracked or defective pipes, fittings and valves discovered during pressure test and replace with new items.

B. Owner's Representative may direct Contractor to disinfect failed lines after repair and prior to retesting. Conduct subsequent disinfection operations in accordance with requirements of Section 02675.

C. Repeat test until satisfactory results are obtained.

3.06 COMPLETION

A. Upon satisfactory completion testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

Hydrostatic Pressure Test Data Sheet
City of Galveston, Texas

Project: _____ Sheet #: _____ Location: _____

Inspector: _____ Contractor: _____

Section to be Tested

	On (street name)	From (street name)	To (street name)	Total Length (ft)	Pipe Diameter (inch)

Test Log

	Hrs	Time	Pressure (PSI)	Flow Meter (GPM)	Leakage*
	Start				N/A
	1				
	2				
	3				
	4				

TOTAL LEAKAGE =

Test Result: (check one) Passed _____ Failed (to be repaired & retested) _____

Inspector: _____ Date: _____

(Signature)

Contractor: _____ Date: _____

(Signature)

*Allowable Leakage per 1000 feet of pipeline in Gallons per hour at 150 psi:													
Line Size	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"
Leakage (GA/HR)	0.25	0.33	0.5	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98
Pres. Drop (PSI/HR)	5	5	5	5	5	5	5	5	5	5	5	5	5

END OF SECTION

SECTION 02712

LIME STABILIZATION OF PAVEMENT SUBGRADE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section includes the requirements for the provision of lime stabilization of pavement subgrade. Add lime to natural subgrade material and compacted embankment. Construct subgrade in conformity with typical sections and to lines, grades and thickness shown.

PART 2 P R O D U C T S

2.01 LIME QUANTITIES

A. The quantity of lime specified shall be 32 to 36 pounds of hydrated lime (by dry weight) per square yard at a depth of 6 inches. The quantity can be adjusted based on field testing and results.

2.02 COMMERCIAL LIME SLURRY

A. Provide a commercial lime slurry with a dry solids content of at least 36 percent (36%) by weight of slurry, and forming a pumpable suspension of solids in water.

B. Water. Provide water containing dissolved matter not injurious or objectionable, either in quantity or in quality.

1. Solids. The solids portion of the mixture must consist principally of hydrated lime meeting the following requirements:

2. The solids content of the lime slurry must have a hydrate alkalinity (CA(OH)2) of not less than 90 percent (90%) by weight.

3. Provide that the percent by weight of residue retained of the solids content of lime slurry conforms to the following:

Sieve	Maximum Percent Retained Residue
No. 6 (3360 micron)	0.0
No. 10 (220 micron)	1.0

C. Any bagged lime furnished shall bear the manufacturer's certified weight.

PART 3 E X E C U T I O N

3.01 PREPARING SUBGRADE

A. Prepare subgrade properly before beginning lime treatment. Subgrade shall be shaped and rolled to finish grades, then scarified to the required depth utilizing the appropriate equipment. Stabilize unstable material below indicated depth by proper compaction.

3.02 PLACEMENT

A. Slurry Placing. Make successive passes over subgrade to be limed. Do not place more lime than can be initially mixed during the same working day.

B. Documentation. Finish copies of delivery tickets, marked with the area the material was deposited at, the date, and the quantity of lime.

3.03 MIXING

A. Procedures. Mixing procedures for either dry placing or slurry placing are the same.

B. Preliminary Mixing.

1. Pulverize soil to minus 2 inches.

2. Add water to bring moisture content of the soil and lime mixture at least 5 percent above optimum.

3. Rotary mix soil, lime and water to required depth, using approved single-pass or multiple-pass rotary speed mixer.

4. After initial mixing, shape the subgrade to the appropriate section. Compact it lightly for preliminary curing.

C. Final Mixing.

1. After preliminary curing, uniformly mix soil and lime to required depth. Use an approved single-pass or multiple–pass rotary speed mixer.

2. Add water to bring moisture content of soil-lime mixture to at least 5 percent above optimum.

3. Continue mixing and pulverizing soil until all clods are broken down to pass a 1-inch screen. At least 70 percent should pass a 3/8-inch sieve, nonslaking fractions excluded.

4. After final mixing, shape subgrade to final section, compact and cure.

D. Exception. If pulverization requirements of final mixing can be met during preliminary mixing, then preliminary curing and final mixing can be eliminated.

3.04 COMPACTION

A. Preliminary Compaction. Seal surface of subgrade by rolling lightly with light pneumatic rollers. Sealing is done as a precaution against heavy rainfall.

B. Final Compaction.

1. Attain optimum moisture content.

2. Begin compaction immediately after final mixing.

3. Begin compacting at the bottom, using approved heavy pneumatic or vibrating rollers, or a combination of tamping roller and light pneumatic roller, until entire depth is uniformly compacted.

4. Compact treated material so as not to mix it with underlying subgrade material.

5. All irregularities, depressions, and weak spots disclosed by passes of a heavy pneumatic roller (proof roller) shall be corrected by replacing with satisfactory material and recompacted as specified.

6. Maintain smooth surface until base course or pavement is placed. Attain at least 95 percent of ASHTO density, using Standard Test Method T-99, at optimum to +5 percent of optimum moisture content of treated material.

7. Use light pneumatic roller for final surface rolling.

3.05 CURING

A. Preliminary Curing. Cure soil-lime material for 2 to 4 days. Keep subgrade moist during cure.

B. Final Curing. Cure the lime-stabilized subgrade for 3 to 7 days, as directed. Keep traffic off during cure, other than a light pneumatic roller. Do not permit vehicles heavier than 10 tons on the subgrade. Use moist curing or membrane curing for final cure.

1. Moist Cure. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

2. Membrane Cure.

a. Apply two coats of asphalt emulsion to subgrade surface the first day after final compaction.

b. Apply one coat each day thereafter for 3 days.

c. Total applications will be 0.25 gallons of asphalt emulsion per square yard of subgrade surface.

END OF SECTION

SECTION 02714

ROAD BASE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Provide compacted flexible base course of crusher-run, broken limestone. Construct base in multiple courses in conformity with typical sections and to lines, grades and thickness shown. Crushed recycled concrete will be allowed in place of limestone if conformance to this specification can be maintained.

PART 2 P R O D U C T S

2.01 SOURCE

A. Extract limestone material from an approved source. Crush it to provide durable particles of stone mixed with approved binding materials. Furnish stone with no more than 35 percent wear when tested by the Los Angeles abrasion test, ASTM C 131.

B. A stockpile may be required, made up of layers of processed material. Load the material by making successive vertical cuts through the entire depth of the stockpile.

2.02 GRADATION

A. Furnish processed material which, when properly slaked and tested by standard laboratory methods, meets the following requirements:

Sieve	Percent Retained
1-3/4-inch	00
7/8-inch	10 to 35
3/8-inch	30 to 50
No. 4	45 to 65
No. 40	70 to 85

2.03 OTHER MEASURES

A. Materials passing Sieve No. 4 will be known as “binder.” That portion of binder material passing No. 40 sieve will be known as “soil binder” and must meet the following requirements:

1. Liquid limit shall not exceed 35.
2. Plasticity index shall not exceed 10.

3. Linear shrinkage shall not exceed 7 (when calculated from volumetric shrinkage at liquid limit).

PART 3 E X E C U T I O N

3.01 SUBGRADE

A. Shape and compact subgrade to lines and grades shown. Repair all soft areas before base material is placed upon subgrade.

3.02 PLACEMENT

A. Place base material in lifts not to exceed 6 inches compacted thickness.

1. First Lift. Place base material only on properly prepared subgrade.

2. Spread and shape so that base material will have a finished thickness not to exceed 6 inches when compacted.

3. Complete all required manipulation the same day material is deposited.

4. Compact base material to 95 percent maximum density as determined by procedures described in AASHTO T-180.

5. Maintain moisture between optimum and 2 percent above optimum moisture.

6. Successive Lifts. Place the successive lifts of base material only when the previous lift has been finished to grade and compacted.

a. Spread and shape the successive lifts of base material so that when compacted the successive lift will have a finished thickness not to exceed 6 inches.

b. Spread base material the same day it is deposited.

c. Compact base material to 95 percent maximum density as determined by procedures described in AASHTO T-180.

d. Maintain moisture between optimum and 2 percent above optimum moisture.

e. Total thickness of flexible base shall be as called for on plans.

3.03 FINISH GRADE

1. Throughout this operation, maintain the shape of the course by grading.

2. Achieve a smooth surface upon completion in conformity with the typical section shown and established lines and grades.

   a. Any deviation in excess of 1/4 inch in cross section or in a length of 16 feet can be corrected by loosening, adding or removing material, reshaping and recompacting, and then by sprinkling and rolling.

   b. Should the base course lose the required stability, density or finish before surfacing is complete, recompact and refinish the base.

   c. Prevent excessive loss of moisture in the completed base by sprinkling.

END OF SECTION

SECTION 02730

GRAVITY SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Gravity sanitary sewers and appurtenances, including cleanouts, stacks, and service connections.

1.02 UNIT PRICES

A. Measurement for payment of pipe is on a unit price per linear foot basis. Measurement will be taken along the centerline of the pipe from centerline to centerline of manholes. Payment will be made for each linear foot installed, complete in place including sewer pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes and pipe, stacks, cleanouts, accessories, inspection and testing..

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all provisions and sections of these specifications.

B. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

1.04 QUALITY ASSURANCE

A. Qualifications. Install a sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Section 02732 - Acceptance Testing for Sanitary Sewers.

B. Regulatory Requirements.

1. Install sewer lines to meet the minimum separation distance from any potable water line, as scheduled below. The separation distance is defined as the distance between the outside of the water pipe and the outside of the sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.

2. Make notification to the Owner's Representative if water lines are uncovered during sanitary sewer installation where the minimum separation distance cannot be maintained.

3. Lay gravity sewer lines in straight alignment and grade.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Inspect pipe and fittings upon arrival of materials at the job site.

B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along the ground. Do not roll pipe unrestrained from delivery trucks.

C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around the outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with the interior surface of the pipe to lift or move lined pipe.

PART 2 P R O D U C T S

2.01 PIPE

A. Provide piping materials for gravity sanitary sewers of the sizes and types indicated on the Drawings or as specified.

B. Reinforced concrete pipe is not acceptable.

2.02 PIPE MATERIAL SCHEDULE

A. Unless otherwise shown on the Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:

1. Section 02610 - Ductile Iron Pipe and Fittings.

2. Section 02618 - Centrifugally Cast Fiberglass Pipe.

3. Section 02619 - HDPE Solid and Profile Wall Pipe.

4. Section 02620 - PVC Pipe.

B. Where shown on the Drawings, provide pipe meeting the minimum class, dimension ratio, or other criteria indicated.

C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

2.03 APPURTENANCES

A. Stacks. Conform to the requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

B. Service Connections. Conform to requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

C. Roof, street or other type of surface water drains shall not be connected or reconnected into the sanitary sewer lines.

2.04 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill: Conform to requirements of Section 02227 - Excavation and Backfill for Utilities, Section 02229 - Utility Backfill Material, and Section 02252 - Cement Stabilized Sand.

B. Topsoil: Conform to requirements of Section 02920 - Topsoil.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Prepare traffic control plans if required, or follow traffic control plan provided within the construction plans, and set up street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01570 - Traffic Control and Regulation.

B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Section 01570 - Traffic Control and Regulation. Maintain barricades and warning lights where work is in progress or where traffic is affected by the work.

C. Perform work in accordance with OSHA standards. Employ a trench safety system as specified in Section 01526 - Trench Safety System for excavations over 5 feet deep.

D. Immediately notify the agency or company owning any utility line which is damaged, broken or disturbed. Obtain approval from the Owner’s Representative and agency or utility company for any repairs or relocations, either temporary or permanent.

E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Section 02076 - Removing Existing Pavements and Structures.

F. Install and operate dewatering and surface water control measures in accordance with Section 01563 - Control of Ground Water and Surface Water.

G. Do not allow sand, debris or runoff to enter sewer system.

3.02 DIVERSION PUMPING

A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from the Owner's Representative.

B. Design piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. No sewage shall be diverted into any area outside of the sanitary sewer.

D. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify the Owner's Representative so that required reporting can be made to the Texas Commission on Environmental Quality and the Environmental Protection Agency.

3.03 EXCAVATION

A. Earthwork. Conform to requirements of Section 02227 - Excavation and Backfill for Utilities. Use bedding as indicated on Drawings.

B. Line and Grade. Establish the required uniform line and grade in the trench as shown in the drawings. Maintain this control for a minimum of 100 feet behind and ahead of the pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of the work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect the boards and location stakes from damage or dislocation.

C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Section 02227 - Excavation and Backfill for Utilities.

3.04 PIPE INSTALLATION BY OPEN CUT

A. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in the following paragraphs.

B. Install pipe only after excavation is completed, the bottom of the trench fine graded, bedding material is installed, and the trench has been approved by the Owner's Representative.

C. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell hole where necessary.

D. Install pipe with the spigot ends toward the direction of flow.

E. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

F. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.

G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Owner's Representative.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

J. If a water line is encountered closer than nine feet to the proposed sewer and no special provisions are indicated on the Drawings, notify the Owner's Representative before proceeding.

K. Where the length of stubs is not indicated, install a 12-inch length and seal the free end with an approved plug.

3.05 PIPE INSTALLATION OTHER THAN OPEN CUT

A. For installation of pipe by augering, or jacking conform to requirements of specification sections on augering or jacking work as appropriate.

3.06 INSTALLATION OF APPURTENANCES

A. Service Connections. Install service connections to conform to requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

B. Stacks. Construct stacks to conform to requirements of 02762 - Sanitary Sewer Service Stubs or Reconnections.

C. Construct manholes to conform to requirements of Section 02600 - Cast-in-Place Manholes, Section 02601 - Precast Concrete Manholes, as applicable. Install frames, rings and covers to conform to requirements of Section 02603 - Frames, Grates, Rings and Covers.

3.07 SEPARATION FROM WATER LINES

A. Water Line/New Sewer Line Separation - When new sanitary sewers are installed, they shall be installed no closer to waterlines than nine feet in all directions. Sewers that parallel waterlines must be installed in separate trenches. Where the nine foot separation distance cannot be achieved, the following guidelines will apply.

1. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron, or PVC pipe meeting ASTM specifications with a pressure rating for both the pipe and joints of 150 psi. The vertical separation shall be a minimum of two feet between outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the waterline.

2. Where a sanitary sewer crosses a waterline and the sewer is constructed of cast iron, ductile iron or PVC with a minimum pressure rating of 150 psi, an absolute minimum distance of 6 inches between outside diameters shall be maintained. In addition the sewer shall be located below the waterline where possible and one length of the sewer pipe must be centered on the waterline.

3. Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe or concrete pipe with gasketed joints, a minimum two foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the waterline. This initial backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.

4. Where a sewer crosses over a waterline all portions of the sewer within nine feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at 5 feet intervals with spacers or be filled to the springline with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.

B. Waterline/Manhole Separation - Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet of horizontal clearance from an existing or proposed waterline. Where the nine foot separation distance cannot be achieved, a carrier pipe as described in subsection (A)(4) of this section may be used where appropriate.

3.08 INSPECTION AND TESTING

A. Visual Inspection. Check pipe alignment in accordance with Section 02732 - Acceptance Testing For Sanitary Sewers.

B. Mandrel Testing. Use a Mandrel Test to test flexible pipe for deflection. Refer to Section 02732 - Acceptance Testing for Sanitary Sewers.

C. Leakage Testing. After backfilling a line segment and prior to tie-in of service connections, test for leakage in accordance with Section 02732 - Acceptance Testing for Sanitary Sewers. Maintain piezometers installed to conform with Section 01563 - Control of Ground Water and Surface Water, until acceptance testing is completed.

D. Owner may elect to perform television inspection of the completed sewer before acceptance. The Contractor will be responsible for traffic control.

3.09 BACKFILL AND SITE CLEANUP

A. Backfill and compact soil in accordance with Section 02227 - Excavation and Backfill for Utilities.

B. Backfill the trench in specified lifts only after pipe installation is approved by the Owner's Representative.

C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Section 02570 - Pavement Repair and Resurfacing.

D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over the surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at a uniform slope to natural grade as indicated on the Drawings. Provide a minimum of 4 inches of topsoil as specified in Section 02920 - Topsoil and apply hydromulch according to requirements of Section 02932 - Hydromulch Seeding.

E. Provide sodding in areas of residential land use or in areas shown in plans over the surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at a uniform slope to natural grade as indicated on the Drawings. Provide a minimum of 4 inches of topsoil per Section 02920 - Topsoil. Sod disturbed areas in accordance with Section 02935 - Sodding.

F. Conform to requirements of Section 01564 - Waster Material Disposal.

END OF SECTION

SECTION 02731

SANITARY SEWER FORCE MAINS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Sanitary sewage force mains.

1.02 UNIT PRICES

A. Measurement for payment for pipe is on a unit price per linear foot basis. Measurement will be taken along the centerline of the pipe from end to end. Payment will be made per foot of force main installed, complete in place including pipe, fittings, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes and pipe, accessories, inspection and testing.

1.03 SUBMITTALS

A. Conform to requirements of all provisions and section of these specifications.

B. Submit proposed methods, equipment, materials, and sequence of operations for force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

C. Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.

D. Submit test reports as specified in Part 3 of this Section.

PART 2 P R O D U C T S

2.01 DUCTILE IRON PIPE AND FITTINGS

A. Conform to requirements of Section 02610 - Ductile Iron Pipe and Fittings.

2.02 PVC PIPE

A. Conform to requirements of Section 02620 - PVC Pipe.

B. Provide lined ductile iron fittings conforming to Section 02610 - Ductile Iron Pipe and Fittings.

2.03 POLYETHYLENE PIPE AND FITTINGS

A. Conform to requirements of Section 02619 - High Density Polyethylene (HDPE) Solid all Pipe

2.04 CENTRIFUGALLY CAST FIBERGLASS PIPE AND FITTINGS

A. Conform to requirements of Section 02618 - Centrifugally Cast Fiberglass Pipe.

2.05 THRUST RESTRAINT

A. Unless otherwise shown on the Drawings, provide concrete thrust blocking for force mains up to 12-inches in diameter, to prevent movement of buried lines under pressure at bends. Blocking shall be Portland cement concrete, as specified in Section 03305 - Concrete for Utility Construction. Place concrete in accordance with details on the Drawings. Place thrust blocks between undisturbed ground and the fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below the pipe or fitting to 12 inches above.

B. For all force mains larger than 12 inches in diameter, and where indicated on the Drawings, provide restrained joints conforming to the requirements of the force main pipe material specifications. Restrained joints shall be installed for the length of pipe on both sides of each bend or fitting for the full length shown on the Drawings.

C. Horizontal and vertical bends between zero and 10 degrees deflection angle will not require thrust blocks or harnessed or restrained joints.

D. Horizontal and vertical bends greater than 10 degrees deflection angle shall have thrust restraint as shown on the Drawings.

E. Reinforced concrete encasement of force main pipe and fittings may be used in lieu of manufactured joint restraint systems. Alternate joint restraint systems using reinforced concrete encasement shall conform to the following design requirements.

1. Design calculations shall be performed and sealed by a Professional Engineer licensed in the State of Texas.

2. Design calculations shall be based upon soil parameters quantified in the geotechnical report for the site where the alternative thrust restraint system is to be installed. If data is not available for the site, use parameters recommended by the geotechnical engineer.

3. The design system pressure shall be the specified test pressure.

4. The following safety factors shall be used in sizing the restraint system:

   a. Apply a factor of safety equal to 1.5 for passive soil resistance.

   b. Apply a factor of safety equal to 2.0 for soil friction.

5. The encasement shall be contained entirely within the standard trench width and terminate on both ends at a pipe bell or coupling.

6. Concrete encasement reinforcement steel shall be designed for all loads including internal pressure and longitudinal forces. Concrete design shall be in accordance with ACI 318.

PART 3 E X E C U T I O N

3.01 PIPE INSTALLATION BY OPEN-CUT

A. Perform excavation, bedding, and backfill in accordance with Section 02227 - Excavation and Backfill for Utilities.

B. Wrap ductile-iron pipe and fittings with polyethylene wrap in accordance with requirements of Section 02630 - Polyethylene Wrap. Polyethylene wrap shall not be installed on ductile iron pipe protected by a cathodic protection system.

C. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in the following paragraphs.

D. Install pipe only after excavation is completed, the bottom of the trench is fine graded, bedding material is installed, and the trench has been approved by the Owner’s Representative.

E. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell holes where necessary.

F. Install pipe with the spigot ends toward the direction of flow. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

G. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.

H. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where

provided. Use of backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Owner's Representative.

I. Keep excavations free of water during construction and until final inspection.

J. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

K. Where sanitary sewer force main is to be installed under an existing waterline with a separation distance of less than 2 feet, install one full joint length of pipe centered on the waterline and maintain a minimum 6-inch separation distance.

3.02 PIPE INSTALLATION OTHER THAN OPEN-CUT

A. For installation of pipe by augering or jacking conform to requirements of specification sections for augering or jacking work.

3.03 HYDROSTATIC TESTING

A. After the pipe and appurtenance have been installed, test line and drain. Prevent damage to the Work or adjacent areas. Use clean water to perform tests.

B. The Owner's Representative may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.

C. Test pipe in the presence of the Owner's Representative.

D. Test pipe at 150 psig or 1.5 times design pressure of the pipe, whichever is greater. Design pressure of the force main shall be the rated total dynamic head of the lift station pump.

E. Test pipe at the required pressure for a minimum of 2 hours according to requirements of UNI-B-3.

F. Maximum allowable leakage shall be as calculated by the following formula:

$$L = (S)\ (D)\ (P0.5) / 133{,}200$$

Where: L Leakage in gallons per hour.

S Length of pipe in feet.

D Inside diameter of pipe in inches.

P Pressure in pounds per square inch.

G. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by the Owner's Representative.

H. Plug openings in the force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering the tested pipeline.

3.04 PIGGING TEST

A. After completion of hydrostatic testing and prior to final acceptance, test force mains longer than 200 feet by pigging to ensure piping is free of obstructions.

B. Pigs: Provide proving pigs manufactured of an open-cell polyurethane foam body, without any coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to 65 percent of the nominal cross-sectional area of the pipe. Pigs shall be able to pass through standard fittings such as 45-degree and 90-degree elbows, crosses, tees, wyes, gate valves, or plug valves, as applicable to the force main being tested.

C. Test Execution: Pigging test shall be conducted in the presence of the Owner's Representative. Provide at least 48-hours notice of scheduled pigging of the force main prior to commencing the test.

END OF SECTION

SECTION 02732

ACCEPTANCE TESTING FOR SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Acceptance testing criteria and procedures for sanitary sewers, including:

1. Visual inspection of sewer pipes.

2. Mandrel testing for flexible sewer pipes.

3. Leakage testing of sewer pipes.

4. Leakage testing of manholes.

5. Smoke testing of point repairs.

6. Post Cleaning and Television Inspection of rehabilitated sanitary sewer.

B. Tests listed in this Section are not necessarily required on this Project. Required test is named in other Sections which refer to this Section for testing criteria and procedures.

1.02 UNIT PRICES

A. No payment will be made for Acceptance Testing for Sanitary Sewers under this section. Payment for work performed as described under this section shall be included in the unit price bid for applicable work items.

1.03 PERFORMANCE REQUIREMENTS

A. Gravity flow sanitary sewers are required to have a straight alignment and uniform grade between manholes.

B. Flexible pipe, including “semi-rigid” pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of a line segment but prior to final acceptance using a standard mandrel to verify that installed pipe is within specified deflection tolerances.

C. Maximum allowable leakage for infiltration or exfiltration.

1. The total exfiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of 2 feet above the crown of the pipe at the upstream manhole or 2 feet above the groundwater elevation, whichever is greater.

2. When pipes are installed more than 2 feet below the groundwater level, an infiltration test shall be used in lieu of the exfiltration test. The total infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above the crown of the pipe at the upstream manhole.

3. Refer to Table 02732-1, Water Test Allowable Leakage, at the end of this Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria are met.

D. Perform air testing in accordance with requirements of this Section and the Texas Commission on Environmental Quality requirements. Refer to Table 02732-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 02732-3, Minimum testing Times for Low Pressure Air Test, and Table 02732-4, Vacuum Test Time Table, at the end of this Section.

1.04 SUBMITTALS

A. Submittals shall conform to all provisions and sections of these specifications.

B. Test Plan: Before testing begins and in adequate time to obtain approval through the submittal process, prepare and submit a test plan for approval by Owner's Representative Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations form the Drawings and Specifications.

C. Test Reports: Submit test reports for each test on each segment of sanitary sewer within 7 days after testing on that segment as performed.

1.05 GRAVITY SANITARY SEWER QUALITY ASSURANCE

A. Remove and replace, and retest manholes or sections of pipe which fail to meet specified requirements when tested.

B. Provide testing reports within 7 days after completion.

1.06 SEQUENCING AND SCHEDULING

A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at any one time.

B. Coordinate testing schedules with The Owner's Representative. Perform testing under observation of the Owner's Representative.

PART 2 P R O D U C T S

2.01 DEFLECTION MANDREL

A. Mandrel Sizing. The rigid mandrel shall have an outside diameter (O.D.) equal to 95 percent of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. Dimensions shall be per appropriate standard. Statistical or other "tolerance package" shall not be considered in mandrel sizing.

B. Mandrel Design. The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75 percent of the inside diameter of the pipe. The rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. A proving ring shall be provided and used for verifying each size mandrel.

C. Proving Ring. Furnish a "proving ring" with each mandrel. Fabricate the ring of 2-inch-thick, 3-inch-wide bar steel to a diameter 0.02-inches larger than approved mandrel diameter.

D. Mandrel Dimensions (5% allowance). Average inside diameter and minimum mandrel diameter are specified in Table 02732-5, Pipe vs. Mandrel Diameter, at the end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in the table may be used when approved by the Owner's Representative.

2.02 EXFILTRATION TEST

A. Test Equipment:

1. Pipe plugs.

2. Pipe risers where the manhole cone is less than 2 feet above highest point in pipe or service lead.

2.03 INFILTRATION TEST

A. Test Equipment:

1. Calibrated 90° V-notch weir.

2. Pipe plugs.

2.04 LOW PRESSURE AIR TEST

A. Minimum Requirement for Equipment:

1. Control panel.

2. Low-pressure air supply connected to control panel.

3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.

4. Air hoses from control panel to:

a. Air supply

b. Pneumatic plugs

c. Sealed line for pressuring

d. Sealed line for monitoring internal pressure

B. Testing Pneumatic Plugs: Place a pneumatic plug in each end of a length of pipe on the ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable if they remain in place against the test pressure without external aids.

2.05 GROUND WATER DETERMINATION

A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

2.06 SMOKE TESTING

A. Equipment:

1. Pneumatic plugs.

2. Smoke generator as supplied by Superior Signal Company, or an approved equal.

3. Blowers producing 2500 scfm minimum.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.

B. The selection of test methods and pressures for gravity sanitary sewers shall be determined based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Section 01563-Control of Ground Water and Surface Water.

3.02 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

A. Check pipe alignment visually by flashing a light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

3.03 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of the line segment.

B. Pull the approved mandrel by hand through sewer sections. Replace any section of sewer not passing the mandrel. Mandrel testing is not required for stubs.

C. Retest repaired or replaced sewer sections.

3.04 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

A. Test Options:

1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.

2. Test new or rehabilitated sanitary sewer manholes with water or low-pressure air. Manholes tested with low-pressure air shall undergo a physical inspection prior to testing.

3. Leakage testing shall be performed after backfilling of a line segment, and prior to tie-in of service connections.

4. If no installed piezometer is within 500 feet of the sewer segment, Contractor shall provide a temporary piezometer for this purpose.

B. Compensating for Ground Water Pressure:

1. Where ground water exists, install a pipe nipple at the same time sewer line is placed. Use a ½ - inch capped pipe nipple approximately 10 inches long. Make the installation through manhole wall on top of the sewer line where line enters manhole.

2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect a clear plastic tube to nipple. Support tube vertically and allow water to rise in the tube. After water stops rising, measure height in feet of water over invert of the pipe. Divide this height by 2.3 feet/psi to determine the ground water pressure to be used in line testing.

C. Exfiltration test:

1. Determine ground water elevation.

2. Plug sewer in downstream manhole.

3. Plug incoming pipes in upstream manhole.

4. Install riser pipe in outgoing pipe of upstream manhole if highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.

5. Fill sewer pipe and manhole or pipe riser, if used, with water to a point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.

6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over a one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure the quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 02732-1 at the end of this section.

D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).

1. Determine ground water elevation.

2. Plug incoming pipes in upstream manhole.

3. Insert calibrated 90° V-notch weir in pipe on downstream manhole.

4. Allow water to rise and flow over weir until it stabilizes.

5. Take five readings of accumulated volume over a period of 2 hours and use average for infiltration. The average must not exceed that calculated for 2 hours from allowable leakage according to the Table 02732-1 at the end of this Section.

E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 02732-2.

1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.

2. Lines 36-inch average inside diameter and larger shall be "joint" tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during a joint test shall be 10 seconds, regardless of pipe size. "Joint Test" shall be conducted as follows:

a. Each joint shall be tested successfully.

b. Joint Tester shall be set over joint to be tested so that the two inflation tubes straddle the joint.

c. Inflate "inflation tubes" to 25 psig to seal off joint to be tested.

d. Apply air pressure into void between inflation tubes until pressure reaches 4 psig.

e. After pressure has stabilized, bleed air pressure back to 3.5 psig.

f. Record time required for pressure to drop from 3.5 psig to 2.5 psig.

g. If the time in seconds for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than 10 seconds, the joint shall be presumed to be free from defect. When the time is less than 10 seconds pipe breakage,

joint leakage or leaking tester seals are indicated and an inspection must be made to determine the cause. The contractor shall effect such repairs as may be required to accomplish a successful air joint test.

h. The joint shall be air tested before the pipe has been backfilled. Air testing shall be performed as pipe installation progresses.

3. For pipe sections less than 36-inch average inside diameter:

a. Determine ground water level.

b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.

c. After a manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.

d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in the system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 02732-2 at the end of this Section.

e. To determine air loss, measure the time interval for pressure to drop to 2.5 psig. The time must exceed that listed in the Table 02732-2 at the end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.

F. Retest: Any section of pipe which fails to meet requirements shall be repaired and retested.

3.05 TEST CRITERIA TABLES

A. Exfiltration and Infiltration Water Tests: Refer to Table 02732-1, Water Test Allowable Leakage, at the end of this Section.

B. Low Pressure Air Test:

1. Times in Table 02732-2, Time Allowed for Pressure Loss From 3.5 psig to 2.5 psig, at the end of this Section, are based on the equation from Texas Commission on Environmental Quality (TCEQ) Design Criteria 317.2(a)(4)(B).

$$T = 0.0850 (D) (K)/ (Q)$$

where:

T = time for pressure to drop 1.0 pounds per square inch gauge in seconds

K = 0.000419 DL, but not less than 1.0

D = average inside diameter in inches

L = length of line of same pipe size in feet

Q = rate of loss, 0.0015 ft^3/min./sq. ft. internal surface

2. Since a K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 02732-3, Minimum Testing Times for Low Pressure Air Test.

3. Notes:

   (a). When two sizes of pipe are involved, the time shall be computed by the ratio of lengths involved.

   (b). Lines with 27-inch average inside diameter and larger may be air tested at each joint.

   (c). Line with an average inside diameter greater than 36 inches must be air tested for leakage at each joint.

   (d). If the joint test is used, a visual inspection of the joint shall be performed immediately after testing.

   (e). For joint test, the pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum times allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

3.06 LEAKAGE TESTING FOR MANHOLES

A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.

B. Plug influent and effluent lines, including service lines, with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs a minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged if lines entering manhole have not been backfilled.

C. Vacuum Testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure; do not overinflate.

2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for the time period specified in Table 02732-4, Vacuum Test Time Table.

3. If the drop in vacuum exceeds 1 inch Hg over the specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

D. Hydrostatic Exfiltration Testing: Hydrostatic exfiltration testing shall be performed as follows:

1. Seal wastewater lines coming into the manhole with an internal pipe plug. Then, fill the manhole with water and maintain it full for at least one hour.

2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot of manhole diameter per foot of manhole depth per hour.

3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3.07 SMOKE TEST PROCEDURE FOR POINT REPAIRS

A. Application: Perform smoke test to:

1. Locate points of line failure for point repair.

2. Determine if point repairs are properly made.

3. Determine if service connections have been reconnected to the rehabilitated sewer.

4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.

B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in a single manhole section at any one time. Keep the number of open excavations to a minimum.

C. Preparation: Prior to smoke testing, give written notice to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to City's Police and Fire Departments 24 hours prior to actual smoke testing.

D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal the annular space at manhole for sliplined sections.

E. Smoke Introduction:

1. Operate equipment according to manufacturer's recommendation and as approved by Owner's Representative.

2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for a minimum of 5 minutes.

3. Introduce smoke into upstream and downstream manholes as appropriate. Monitor the tap/connection for smoke leaks. Note sources of leaks.

F. Repair and Retest: Repair and replace any taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at a time. If repair or replacement, testing or retesting, and backfilling of the excavation is not completed within one workday, properly barricade and cover each excavation as approved by Owner's Representative.

G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to the newly installed liner pipe, perform a dye test to confirm reconnection. Introduce dye into the service line through a plumbing fixture inside the structure or a sewer cleanout immediately outside the structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms a reconnection.

TABLE 02732-1
WATER TEST ALLOWABLE LEAKAGE

DIAMETER OF RISER OR STACK IN INCHES	VOLUME PER INCH OF DEPTH		ALLOWANCE LEAKAGE*	
	Inch	Gallons	Pipe Size in Inches	Gallon/Minute per 100 Ft.
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	10	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value for 1" diameter.			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours.	

* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within the 25-year flood plain

TABLE 02732-2

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG

Pipe Diameter (in)	Minimum Time (min. sec)	Length for Minimum Time (ft)	Time for Longer Length (sec/ft)	Specification Time for Length (L) Shown (min. sec)										
				100 ft.	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

TABLE 02732-3

MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

PIPE DIAMETER (inches)	MINIMUM TIME (seconds)	LENGTH FOR MINIMUM TIME (feet)	TIME FOR LONGER LENGTH (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	25.856 (L)

TABLE 02732-4

VACUUM TEST TIME TABLE

DEPTH IN FEET	TIME IN SECONDS BY PIPE DIAMETER		
	48"	60"	72"
4	10	13	16
8	20	26	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
(T)	5.0	6.5	8.0

* Add T times for each additional 2-foot depth.

(The values listed above have been extrapolated from ASTM C 924-85)

TABLE 02732-5

PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size(Inches)	Average I.D. (Inches)	Minimum Mandrel Diameter
PVC-Solid (SDR 26)	6	5.764	5.476
	8	7.715	7.329
	10	9.646	9.162
PVC-Solid (SDR 35)	12	11.737	11.150
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC-Truss	8	7.750	7.363
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F 794)	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
	48	47.500	45.125
HDPE-Profile	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
	60	60.000	57.000
Fiberglass-Centrifugally Cast (Class SN	12	12.85	11.822
	18	18.66	17.727
	20	20.68	19.646
	24	24.72	23.484
	30	30.68	29.146
	36	36.74	34.903
	42	42.70	40.565
	48	48.76	46.322
	54	54.82	52.079
	60	60.38	57.361

Mandrel Test Data Sheet
City of Galveston, Texas

Date: _____ Project: _____

Material: _____ Sheet #: _____ Max Allowed Deflection: _____

Upstream MH Sta. #	Downstream MH Sta. #	Pipe Dia. (inches)	Length (feet	Pass or Fail

Inspector: _____ Date: _____

(Signature)

Contractor: _____ Date: _____

(Signature)

PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size (Inches)	Average I.D> (Inches)	Minimum Mandrel Diameter (Inches)
PVC-Solid (SDR 26)	6	5.764	5.476
	8	7.715	7.329
	10	9.646	9.162
PVC-SOLID (SDR 35)	12	11.737	11.150
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC-Truss	8	7.750	7.363
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F 794)	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
	48	47.500	45.125
HDPE-Profile	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
	60	60.000	57.000

Fiberglass-Centrifugally	12	12.850	11.822
	18	18.660	17.727
	20	20.680	19.646
	24	24.720	23.484
	30	30.680	29.146
	36	36.740	34.903
	42	42.700	40.565
	48	48.760	46.322
	54	54.820	52.079
	60	60.380	57.361

Leakage Testing for Sanitary Sewer Lines
City of Galveston, Texas

Project: _____ Sheet #: _____ Location: _____

Inspector: _____ Date: _____ Contractor: _____

Line Test Log

Test #	Manhole UP	Manhole Down	Line Length	Line Diameter	Avg. Depth of Line	Avg. Depth of Ground-water	Start Air Pressure	End Air Pressure	Time Elapsed	Time Allowed (per table*)	Pass or Fail	Inspector	Contractor
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG

Pipe Dia. (in)	Min. Time (min. sec.)	Length for Min. Time (ft)	Time for Longer Length (sec/ft)	Specification Time for Length (L) Shown (min. sec.)										
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.	500 ft.	550 ft.	600 ft.
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.419	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	157	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.7408	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.369	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

END OF SECTION

SECTION 02790

DIVERSION PUMPING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Use of by-pass pumping to prevent surcharging and maintain un-interrupted flow through sewage collection system while allowing Contractor to provide reliable sewer service to the sanitary sewer users at all times and to isolate sewer line manholes and/or sewer line segments designated for cleaning, rehabilitation, and television inspection operations. Includes installation and operation of bulkheads, plugs, hoses, piping and pumps to maintain sewage flow and prevent backup and overflow.

1.02 UNIT PRICES

A. No separate payment for work performed under this item, unless stated in the bid proposal. Include cost of same in contract price bid for items of work which it is a component.

PART 2 M A T E R I A L S

2.01 PUMPS

A. When well-pointing in residential areas, utilize noise reducing pumps and said pumps must be approved by the Owner.

B. Pumps and/or generators must be provided with noise attenuators when pumping is required after hours.

2.02 PIPING, JOINTS AND ACCESSORIES

A. All piping, joints and accessories shall be designed to withstand at least twice the maximum system pressure or a minimum of 50 psi which ever is greater and be leak free.

PART 3 E X E C U T I O N

3.01 PROCEDURES AND METHODS

A. Prior to beginning sewer cleaning, rehabilitation and television inspection operations demonstrate pumping system is in good working order.

B. Prior to isolating sewer manhole and/or line segment for beginning work have all materials, equipment and labor necessary to complete sewer on job site.

C. Locate pumping suction and discharge lines so as not to cause undue interference with the use of streets, private driveways entrances or residences.

D. All piping, joints and accessories shall be designed to withstand at least twice the maximum system pressure or a minimum of 50 psi whichever is greater.

E. Plug off and pump down sewer manhole or line segment in designated area. Maintain sanitary sewer system so that surcharging does not occur.

F. Complete sewer cleaning, rehabilitation and television inspection operations as quickly as possible.

G. An experienced operator shall be on site at all times to monitor the operation, adjust pump speed, valves, etc.

H. Furnish all labor, materials, supervision and equipment necessary for maintaining the pumping system in continuous proper working order for the duration of cleaning, rehabilitation and television inspection operations. Obtain approval of discharge location for diversion pumping system prior to commencing work. Under no condition will raw sewage be allowed to discharge in open ditches, streets, or storm sewer systems or in any way that would create unsanitary conditions or interfere unduly with the use of streets, private driveways entrances or residences. Whenever flows in a sewer line are blocked, plugged or bypassed, sufficient precautions must be taken to protect the sewer lines from damage. Ensure that sewer line cleaning, rehabilitation and television inspection and/or by-pass operations do not cause flooding or damage to public or private property being served by the sewer lines involved in the repair. The Contractor is responsible for having additional stand by pumps in the event of failure of any pumps.

I. In the event sewage accidentally drains into the drainage system or street, the Contractor shall immediately stop the overflow, notify the Owner's Representative and cleanup and disinfect the spillage to the satisfaction of the Owner's Representative.

1. In the event the sewage is spilled onto public or private property, the Contractor shall wash down, clean up and disinfect the spillage to the private owner's/ Owner's Representative satisfaction.

2. Overflow/spillage shall be reported to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA) by the Contractor within 24 hours.

J. When diversion pumping operations are complete, piping shall be drained into the sanitary sewer prior to disassembly.

END OF SECTION

SECTION 02831

CHAIN LINK FENCES AND GATES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Fence framework, fabric, and accessories.

B. Excavation for post bases, concrete foundation for posts and center drop for gates.

1. Manual gates and related hardware.

1.02 MEASUREMENT AND PAYMENT

A. Payment for fencing shall be on a linear foot basis for height noted.

B. Payment for gates shall be per unit.

1.03 SYSTEM DESCRIPTION

A. Fence Height shall be as indicated on Drawings or as noted to match height of existing.

B. Extension arms for barbed wire shall match existing.

C. Line Post Spacing shall not exceed 10 feet, or as shown on Drawings.

1.04 SUBMITTALS

A. Submit in accordance with all sections and provisions of these specifications.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

C. Product Data: Provide data on fabric, posts, accessories, fittings and hardware that indicates that items match or exceed the quality of existing.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

1.06 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 P R O D U C T S

2.01 GALVANIZED FENCING

A. Fence fabric shall be No. 9 steel wire, hot galvanized after weaving, to match or exceed existing.

B. Framework shall be hot-dipped galvanized with a minimum coating of 2 ounces/sf, or one ounce/sf plus 30 micrograms/square inch chromate conversion coating.

C. Line posts shall conform to ASTM A570 Grade 45 steel or ASTM A569, cold rolled steel.

D. End corner, angle, and pull posts shall conform to ASTM A570 Grade 45 steel or ASTM A569 for steel pipe.

E. Top rails shall be 1.65 x 1.25-inch formed C-section; or 1.6-inch round ASTM A569, 1.35 lbs/ft; or 1-5/8-inch outside diameter steel pipe, 2.27 lbs/ft. Top rails shall pass through openings provided for that purpose in post tops.

F. Fabric ties shall be hog rings, galvanized steel wire not less than 9-ga with a zinc coating of not less than 1.2 ounces/sf.

G. Bolts and nuts shall be in conformance with ASTM A307 and shall be galvanized in accordance with AASHTO M232.

H. Install horizontal braces fabricated of 1-5/8-inch, 2.27-lb copper bearing steel pipe at all corner, gate, and end posts.

I. Gates shall be either swing or slide as shown on the plans. Swing gates shall be hinged to swing 90 degrees from closed to open or hinged to swing 180 degrees from close to open. Slide gates shall be roller type with no vertical obstructions. All gate leaves shall have intermediate members and diagonal stress rods as required for rigid construction and shall be free from sag or twist. All gates shall be fitted with vertical extension arms or shall have frame end number extended to carry barbed wire. Gateposts for gates shall be 4-inch, 9.1 lb pipe. Gate frames shall be made of 2-inch outside diameter, castings. Fabric shall be the same as for the fence. Gates shall have malleable iron ball and socket hinges, catches, stops and padlocks with 3 keys each. Posts for single gates shall be the same as end posts.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install chain link fence in accordance with the directions of the manufacturer and these Specifications.

B. Install fence posts at not more than 10-ft centers and at least 36 inches into the ground in a Class B concrete base. Allow concrete to cure for at least 7 days before erecting remainder of fence. Fasten fabric to line posts with wire ties spaced about 14 inches apart and to top rail spaced about 24 inches apart.

C. Use standard chain link fence stretching equipment to stretch the fabric before tying it to the rails and posts. Repeat the stretching and tying operations about every 100 feet.

D. Erect gates so they swing or slide in the appropriate direction. Provide gate stops as required. Secure hardware, adjust, and leave in perfect working order. Adjust hinges and diagonal bracing so that gates will hang level. Adjust rollers and guides of sliding gates so that gates are level.

E. At small natural or drainage ditches where it is not practical for the fence to conform to the contour of the ground, span the opening below the fence with wire fastened to stakes of required length. The finished fence shall be plumb, taut, true to line and ground contour. When directed, stake down the chain link fence at several points between posts.

F. Where new fence joins an existing fence, set a corner post and brace post at the junction and brace as directed. If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace.

G. Slats shall be used when specified on the drawings.

END OF SECTION

SECTION 02920

TOPSOIL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Furnishing and placing topsoil for finish grading and for seeding, sodding and planting.

1.02 UNIT PRICES

A. No separate payment will be made for topsoil. Include payment in Section 02932 - Hydromuch Seeding and Section 02935 - Sodding.

PART 2 P R O D U C T S

2.01 TOPSOIL

A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having the following characteristics:

1. pH value of between 5.5 and 6.5.

2. Liquid limit: topsoil not exceed 50

3. Plasticity index: 10 or less.

4. Gradation: maximum of 40 percent with a passing the #280 sieve.

B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.

C. Obtain topsoil from naturally well-drained areas where topsoil occurs at a minimum depth of 4 inches and has similar characteristics to that found at the placement site. Do not obtain topsoil from areas infected with a growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify that excavation and embankment operations have been completed to correct lines and grades.

3.02 TOPSOIL EXCAVATION

A. Conform to excavation and stockpiling requirements of section 02225 - Roadway Excavation.

3.03 PLACEMENT

A. For areas to be seeded or sodded, scarify or plow existing material to a minimum depth of 4 inches, or as indicated on the Drawings. Remove any vegetation and foreign inorganic material. Place 4 inches of topsoil on the loosened material and roll lightly with an appropriate lawn roller to consolidate the topsoil.

B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Section 02229 - Utility Backfill Material.

C. For areas to receive bushes or trees, excavate existing material and place topsoil to the depth and dimensions shown on the Drawings.

D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Section 01564 - Waste Material Disposal.

3.04 PROTECTION

A. Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION

SECTION 02932

HYDROMULCH SEEDING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Seeding, fertilizing, mulching, and maintenance of areas indicated on Drawings.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this Section unless unit cost is included in the Bid Proposal. Include cost for such work in unit cost for utility in the Bid Proposal.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all provisions and sections of these specifications.

B. Submit certification from supplier that each type of seed conforms to these specification requirements and the requirements of the Texas Seed Law. Certification shall accompany seed delivery.

C. Submit a certificate stating that fertilizer complies with these specification requirements and the requirements of the Texas Fertilizer Law.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Topsoil: Conform to material requirements of Section 02920 - Topsoil.

B. Seed: Conform to U.S. Department of Agriculture rules and regulations of the Federal Seed Act and the Texas Seed Law. Seed shall be certified 90 percent pure and furnish 85 percent germination and meet the following requirements:

1. Rye: Fresh, clean, Italian rye grass seed (lollium multi-florum), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.

2. Bermuda: Extra-fancy, treated, lawn type common bermuda (Cynodon dactylon). Deliver in original, unopened container showing weight, analysis, name of vender, and germination test results.

3. Wet, moldy, or otherwise damaged seed will not be accepted.

4. Seed requirements, application rates and planting dates are:

Type	Application Rate Pounds/A	Planting Date
Hulled Common Bermuda Grass 98/88	40	Jan 1 to Mar 31
Unhulled Common Bermuda Grass 98/88	40	
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88	40	Oct 1 to Dec 31
Unhulled Common Bermuda Grass 98/88	40	
Annual Rye Grass (Gulf)	30	

C. Fertilizer: Dry and free flowing, inorganic, water-soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear the manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of the following elements:

Nitrogen	10 Percent
Phosphoric Acid	20 Percent
Potash	10 Percent

D. Mulch: Virgin wood cellulose fibers from whole wood chips having a minimum of 20 percent fibers 0.42 inches (10.7 mm) in length and 0.01 inches (0.27 mm) in diameter. Mulch shall be dyed green for coverage verification purposes.

E. Soil Stabilizer: "Terra Tack" 1 or approved equal.

F. Weed control agent: Pre-emergent herbicide for grass areas, "Benefin" or approved equal.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Place and compact topsoil in accordance with requirements of Section 02920 - Topsoil.

3.02 APPLICATION

A. Seed: Apply uniformly at rates given in Paragraph 2.01 B for type of seed and planting date.

B. Fertilizer: Apply uniformly at a rate of 500 pounds per acre.

C. Mulch: Apply uniformly at a rate of 50 pounds per 1000 square feet.

D. Soil stabilizer: Apply uniformly at a rate of 40 pounds per acre.

E. Weed control agent: Apply at manufacturer's recommended rate prior to hydromulching.

F. Suspend all operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold with Owner' approval. Obtain the Owner's Representative's approval before resuming operations.

3.03 MAINTENANCE

A. Maintain grassed areas a minimum of 90 days, or as required to establish an acceptable lawn with 85% coverage. No acceptance will be given until coverage is at least 85%. For areas seeded in the fall, continue maintenance the following spring until an acceptable lawn is established.

B. Maintain grassed areas by watering, fertilizing, weeding, and trimming.

C. Repair areas damaged by erosion by regrading, rolling and replanting.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Design, construction, erection and removal of structural concrete formwork.

1.02 UNIT PRICES

A. No separate payment will be made for concrete formwork under this Section. Include payment in unit price for structural concrete.

1.03 SUBMITTALS

A. Conform to all provisions and sections of these specifications.

B. Shop Drawings: Show location, member size and loading of shoring. When reshoring is permitted, submit plans showing locations and member size of reshoring.

C. Product Data and Samples:

1. Corrugated Fiberboard Carton Forms: Submit certification of compliance with design criteria, description of forms, and one-foot-long sample.

2. Form-coating Materials: Submit trade or brand names of manufacturers and complete description of products.

3. Form ties and related accessories, including taper tie plugs, if taper ties are used.

4. Form gaskets.

D. Detailed Layout for Slip-forming: Submit detailed layout of proposed slipforming, including description of equipment, rate of progress, and other data to show suitability of method. Show provisions for ensuring attainment of required concrete surface finish.

PART 2 P R O D U C T S

2.01 MATERIAL

A. Smooth Forms: New plywood, metal, plastic, tempered concrete-form hardboard, dressed lumber faced with plywood or fiberboard lining, or metal-framed plywood-faced panel material, to provide continuous, straight, smooth surfaces. Form material shall be free of raised grain, torn surfaces, worn edges, patches, dents or other defects. Furnish material in largest practical sizes to minimize number of joints and, when indicated on Drawings, conform to joint system indicated. Form material shall have sufficient strength and thickness to withstand pressure of newly placed concrete without bow or deflection.

B. Rough Forms: Plywood, metal, dressed or undressed lumber free of knots, splits or other defects or other material acceptable to the Owner's Representative of sufficient strength and thickness to withstand pressure of newly placed concrete without bow or deflection.

C. Plywood: Conform to PS 1, Class 1.

D. Lumber: Conform to PS 20.

E. Edge Forms and Intermediate Screed Strips: Type and strength compatible with the screed equipment and methods used.

F. Plastic Forms: One-piece forms for domes, beams and pan joists. Single lengths for columns not exceeding height of 7'-6". For columns over 7'-6", use 7'-6" sections and filler sections as needed. To facilitate removal of pan joist forms, taper sides 1 inch per foot.

G. Metal Pan Joist Forms: Removable type; fabricated of minimum 14-gage steel; one piece between end closures. Adjustable forms not allowed. Taper sides 1 inch per foot to facilitate removal.

H. Earth Cuts for Forms:

1. Use earth cuts for forming unexposed sides of grade beams cast monolithically with slabs on grade.

2. Where sides of excavations are stable enough to prevent caving or sloughing, following surfaces may be cast against neat-cut excavations:

a. Sides of footings.

b. Inside face of perimeter grade beams not monolithic with slab on grade. When inside face is cast against earth, increase beam width indicated on Drawings by 1 inch.

c. Both faces of interior grade beams not monolithic with slab on grade. When grade beam is cast against earth, increase beam width indicated on Drawings by 2 inches.

I. Corrugated Fiberboard Carton Forms:

1. Corrugated fiberboard carton forms, when called for, are intended to form a void space beneath pile-supported and pier-supported slabs and other structural elements as shown.

2. Provide products of a reputable manufacturer regularly engaged in commercial production of double-faced corrugated fiberboard carton forms, constructed of waterproof paper and laminated with waterproof adhesive.

3. Fiberboard forms: Capable of supporting required dead load plus construction loads, and designed to lose their strength upon prolonged contact with moisture and soil bacteria.

4. Seal cuts and ends of each form section by dipping in waterproof wax, unless liners and flutes are completely impregnated with waterproofing.

5. Size forms as indicated on Drawings. Assemble as recommended by manufacturer, either with steel banding at 4'-0" maximum on centers, or, where liners and flutes are impregnated with waterproofing, with adequate stapling.

J. Circular Forms:

1. Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation. Provide manufacturer's seamless units to minimize spiral gaps and seams.

2. Fiberglass or steel forms may be used for round-section members.

K. Shores: Wood or adjustable metal, with bearing plates; with double wedges at lower end.

L. Form Ties:

1. Use commercially-manufactured ties, hangers and other accessories for embedding in concrete. Do not use wire not commercially fabricated for use as a form accessory.

2. Fabricate ties so ends or end fasteners can be removed without causing spalling of concrete faces. Depth from formed concrete face to the embedded portion: At least 1 inch, or twice the minimum dimension of tie, whichever is greater.

3. Provide waterstop feature for form ties used on liquid-containing structures and on concrete walls which will have earth backfill on one side.

4. Removable ties: Taper ties may be used when approved by the Owner's Representative. In the hole left by the removal of the taper tie, insert a preformed neoprene or polyurethane plug sized to seat at the center of the wall.

M. Form Coating: Commercial formulation of form oil or form-release agent having proven satisfactory performance. Coating shall not bond with, stain or otherwise adversely affect concrete surfaces, or impair their subsequent treatment, including application of bonding agents, curing compounds, paint, protective liners and membrane waterproofing.

N. Coating for Plastic Forms: Alkali-resistant gel-coat.

O. Chamfer Strips: Unless otherwise indicated on Drawings, provide 3/4 inch chamfer strips in corners of forms to produce beveled edges where required by Part 3, Execution.

P. Form Gaskets: Polyethylene rod, closed cell, 1-inch diameter.

2.02 DESIGN OF FORMWORK

A. Conform to ACI 117, ACI 347 and building codes, unless more restrictive requirements are specified or shown on Drawings. Contractor shall design and engineer concrete formwork, including shoring and bracing. Design formwork for applicable gravity loads, lateral pressure, wind loads and allowable stresses. Camber formwork to compensate for anticipated deflection during placement of concrete when required to maintain specified tolerances. Design formwork to be readily removed without impact, shock or damage to concrete surfaces and adjacent materials.

B. Slip Forming: Permitted on written approval of the Owner's Representative. Contractor shall demonstrate suitability of method proposed.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Formwork Construction

1. Construct and maintain formwork so that it will maintain correct sizes of members, shape, alignment, elevation and position during concrete placement and until concrete has gained sufficient strength. Provide for required openings, offsets, sinkages, keyways, recesses, moldings, anchorages and inserts.

2. Construct forms for easy removal without damage to concrete surfaces.

3. Make formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins. Provide gaskets for wall forms to prevent concrete paste leakage at their base.

4. Place chamfer strips in forms to bevel edges and corners permanently exposed to view, except top edges of walls, and slabs which are indicated on Drawings to be tooled. Do not bevel edges of formed joints and interior corners unless indicated on Drawings. Form beveled edges for vertical and horizontal corners of equipment bases. Unless otherwise indicated on Drawings, make bevels 3/4 inch wide.

5. Provide temporary openings at bases of column and wall forms and other points as required for observation and cleaning immediately before concrete is placed.

6. Where runways are required for moving equipment, support runways directly on the formwork or structural members. Do not allow runways or supports to rest on reinforcing steel.

7. Use smooth forms on formed concrete surfaces required to have smooth form finish or rubbed finish as specified in Section 03345 - Concrete Finishing.

8. Rough forms may be used on formed concrete surfaces indicated to have rough form finish as specified in Section 03345 - Concrete Finishing.

B. Forms for Surfaces Requiring Smooth Form Finish:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Uniformly space form ties and align in horizontal and vertical rows. Install taper ties, if used, with the large end on the wet face of the wall.

2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back up joints with extra studs or girts to maintain true, square intersections.

3. Form molding shapes, recesses and projections with smooth-finish materials and install in forms with sealed joints to prevent displacement.

4. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines.

5. Provide exterior exposed edges with 3/4-inch chamfer or 3/4-inch radius.

6. Arrange facing material in orderly and symmetrical fashion. Keep number of joints to practical minimum. Support facing material adequately to prevent deflection in excess of allowable tolerances.

7. For flush surfaces exposed to view in completed structure, overlap previously-placed hardened concrete with form sheathing by approximately 1 inch. Hold forms against hardened concrete to maintain true surfaces, preventing offsets or loss of mortar.

C. Forms for Surfaces Requiring Rubbed Finish: Provide forms as specified in paragraph 3.01B, Smooth Form Finish. Use smooth plywood or fiberboard linings or forms, in as large sheets as practicable, and with smooth, even edges and close joints.

D. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure supports for types of screeds required.

E. Circular Forms: Set forms in one piece for full height of member.

F. Surfaces to Receive Membrane Waterproofing: Coordinate surface finish, anchors, reglets and similar requirements with membrane waterproofing applicator.

G. Fireproofing Steel Member: Construct forms to provide not less than the concrete thickness necessary, measured from face of steel member, to provide the required fire rating. Forms for concealed surfaces may be unlined.

H. Tolerances:

1. Unless noted otherwise on Drawings, construct formwork so concrete surfaces will conform to tolerance limits listed in Tables 03100A and 03100B at end of this Section.

2. Establish sufficient control points and benchmarks as references for tolerance checks. Maintain these references in undisturbed condition until final completion and acceptance of the work.

I. Adjustment of Formwork:

1. Use wedges or jacks to provide positive adjustment of shores and struts. After final inspection and before concrete placement, fasten in position wedges used for final adjustment of forms.

2. Brace forms securely against lateral deflections. Prepare to compensate for settling during concrete placement.

3. For wall openings, construct wood forms that facilitate necessary loosening to counteract swelling of forms.

J. Corrugated Fiberboard Carton Forms:

1. Place on smooth firm bed of suitable material to prevent vertical displacement; set tight to prevent horizontal displacement. Exercise care to avoid buckling of forms. Install in accordance with manufacturer's directions and recommendations.

2. Fit carton forms tightly around piles and piers; completely fill the space between subgrade and concrete placement with carton forms to form a void space.

3. Protect carton forms from moisture and maintain in a dry condition until concrete is placed on them. If they become wet before placement of concrete, allow them to dry and carefully inspect for strength before concrete is placed.

4. Before concrete placement, replace damaged or deteriorated forms which are incapable of supporting concrete dead load plus construction live loads.

3.02 PREPARATION OF FORM SURFACES

A. Clean surfaces of forms and embedded materials before placing concrete. Remove accumulated mortar, grout, rust and other foreign matter.

B. Coat forms for exposed or painted concrete surfaces with form oil or form-release agent before placing reinforcement. Cover form surfaces with coating material in accordance with manufacturer's printed instructions. Do not allow excess coating material to accumulate in forms or to contact hardened concrete against which fresh concrete will be placed. Remove coating material from reinforcement before placing concrete.

C. Forms for unexposed surfaces, other than retained-in-place metal forms, may be wet with water immediately before concrete placement in lieu of coating. When possibility of freezing temperatures exists, however, the use of coating is mandatory.

3.03 REMOVAL OF FORMS

A. Time Limits:

1. When repair of surface defects or finishing is required before concrete is aged, forms on vertical surfaces may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.

2. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete. Leave formwork for water-retaining structures in place for at least 4 days. Formwork for non-water-retaining columns, walls, sides of beams and other formwork components not supporting weight of concrete may be removed after 12 hours, provided concrete has hardened sufficiently to resist damage from removal operations, and provided removal of forms will not disturb members supporting weight of concrete.

3. Forms and shoring supporting weight of concrete or construction loads: Leave in place until concrete has reached minimum strength specified for removal of forms and shoring. Do not remove such forms in less than 4 days.

B. Circular Paper or Spiral Tube Forms: Follow manufacturer's directions for form removal. Take necessary precautions to prevent damage to concrete surface. When removal is done before completion of curing time, replace form, tie in place and seal to retard escape of moisture.

C. Removal Strength:

1. Control Tests: Suitable strength-control tests will be required as evidence that concrete has attained specified strength for removal of formwork or shoring supporting weight of concrete in beams, slabs and other structural members. Furnish test cylinders and data to verify strength for early form removal.

a. Field-cured Test Cylinders: When field-cured test cylinders reach specified removal strength, formwork or shoring may be removed from respective concrete placements.

b. Laboratory-cured Test Cylinders: When concrete has been cured as specified for structural concrete for same time period required by laboratory-cured cylinders to reach specified strength, formwork or shoring may be removed from respective concrete placements. Determine length of time that concrete has been cured by totaling the days or fractions of days, not necessarily consecutive, during which air temperature surrounding concrete is above 50 degrees F and concrete

has been damp or thoroughly sealed against evaporation and loss of moisture.

2. Compressive Strengths: The minimum concrete compressive strength for removal of formwork supporting weight of concrete is 75 percent of specified minimum 28-day strength for class of concrete involved.

3.04 RESHORING

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

B. Place reshores as soon as practicable after form-stripping operations are complete but in no case later than end of day on which stripping occurs. Tighten reshores to carry required loads without over stressing construction. Leave reshores in place until tests representative of concrete being supported have reached specified strength at time of removal of formwork supporting weight of concrete.

C. Floors supporting shores under newly-placed concrete: Leave original supporting shores in place, or re-shore. Locate reshores directly under shore position above. Extend reshoring over a sufficient number of stories to distribute weight of newly-placed concrete, forms and construction live loads in such manner that design superimposed loads of floors supporting shores are not exceeded.

3.05 FORM REUSE

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

TABLE 03100A

TOLERANCES FOR FORMED SURFACES CONCRETE IN BUILDINGS**

VARIATION FROM	VARIATION IN	FOR ANY 10-FOOT LENGTH	FOR ANY 20-FOOT LENGTH OR ANY BAY	MAXIMUM FOR ENTIRE DIMENSION
PLUMB OR SPECIFIED BATTER	Lines And Surfaces of Columns, Piers, Walls And Arrises	1/4"	---	1"
	Exposed Corner Columns, Control Joint Grooves, And Other Conspicuous Lines	---	1/4"	1/2"
LEVEL OR SPECIFIED GRADE	Slab Soffits, Ceilings, Beam Soffits, And Arrises (Measured Before Removal of Shores)	1/4"	3/8"	3/4"
	Exposed Lintels, Sills, Parapets, Horizontal Grooves And Other Conspicuous Lines	---	1/4"	1/2"
DRAWING DIMENSIONS	Position of Linear Building Lines, Columns, Walls, And Partitions	---	1/2"	1"
	Size And Location of Sleeves, Floor Openings And Wall Openings	---	---	±1/4"
	Cross Section of Columns, Beams, Slabs, And Walls	---	---	+1/2", -1/4"
	Footings* in Plan	---	---	+2", -1/2"
	Footing Misplacement or Eccentricity in Direction of Error (The Lesser Of)	---	---	2% OF WIDTH OR 2"
	Footing Thickness Decrease	---	---	5%
	Footing Thickness Increase	---	---	NO LIMIT
	Step Rise in Flight of Stairs	---	---	±1/8"
	Step Tread in Flight of Stairs	---	---	±1/4"
	Consecutive Step Rise	---	---	±1/16"
	Consecutive Step Tread	---	---	±1/8"

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

** Includes water and wastewater process structures.

TABLE 03100B
TOLERANCES FOR FORMED SURFACES
CONCRETE IN BRIDGES, WHARVES AND MARINE STRUCTURES

VARIATION FROM	VARIATION IN	MAXIMUM
PLUMB OR SPECIFIED BATTER	Surfaces of columns, piers and walls	1/2" in 10'
LEVEL OR SPECIFIED GRADE	Top surfaces of slabs	See Section 03345
	Top surfaces of curbs and railings	3/16" in 10'
DRAWING DIMENSIONS	Cross section of columns, caps, walls, beams and similar members	+1/2", -1/4"
	Thickness of deck slabs	+1/4", - 1/8"
	Size and location of slab and wall openings	± 1/2"
	Footings in plans	+2", -1/2"
	Footing misplacement or eccentricity in direction of error (the lesser of)	2% of Width or 2"
	Footing thickness decrease	5%
	Footing thickness increase	No Limit
	Step rise in flight of stairs	±1/8"
	Step tread in flight of stairs	±1/4"
	Consecutive step rise	±1/16"
	Consecutive step tread	±1/8"

END OF SECTION

SECTION 03210

REINFORCING STEEL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

Structural concrete reinforcement and grouting of reinforcement dowel bars into hardened concrete.

1.02 UNIT PRICES

No separate payment will be made for reinforcing steel or grouting that is part of the Work as bid. Include payment in unit price for structural concrete.

1.03 SUBMITTALS

Conform to all provisions and sections in these specifications.
Shop Drawings:

1. Submit shop drawings detailing reinforcement fabrication, bar placement location, splices, spacing, bar designation, bar type, length, size, bending, number of bars, bar support type and other pertinent information, including dimensions. Provide sufficient detail for placement of reinforcement without use of Contract Drawings. Information shall correspond directly to data listed on bill of materials.

2. Use of reproductions of Contract Drawings by Contractor, Subcontractor, erector, fabricator or material supplier in preparation of shop drawings (or in lieu of preparation of shop drawings) signifies acceptance by that party of information shown thereon as correct, and acceptance of obligation to pay for any job expense, real or implied, arising due to errors that may occur thereon. Remove references to Design Engineer, including seals, when reproductions of Contract Drawings are used as shop drawings.

3. Detail shop drawings in accordance with ACI 315, Figure 6.

4. Submit shop drawings showing location of proposed additional construction joints as required under Section 03250 - Joints in Concrete Structures, and obtain approval of the Owner’s Representative, prior to submitting reinforcing steel shop drawings.

Bill of Materials: Submit with shop drawings.
Product Data:

5. Mechanical Bar Splices: Submit manufacturer's technical literature, including specifications and installation instructions.

6. Epoxy grout proposed for anchoring reinforcing dowels to hardened concrete: Submit manufacturer's technical literature including recommended installation procedures.

Certificates:

7. Submit steel manufacturer's certificates of mill tests giving properties of steel proposed for use. List manufacturer's test number, heat number, chemical analysis, yield point, tensile strength and percentage of elongation. Identify proposed location of steel in work.

8. Foreign-manufactured reinforcing bars shall be tested for conformance to ASTM requirements by a certified independent testing laboratory located in United States. Certification from any other source is not acceptable. Submit test reports for review. Do not begin fabrication of reinforcement until material has been approved.

1.04 HANDLING AND STORAGE

Store steel reinforcement above ground on platforms, skids or other supports. Protect reinforcing from mechanical injury, surface deterioration and formation of excessive, loose or flaky rust caused by exposure to weather. Protect epoxy-coated reinforcing from formation of any amount of rust.

1.05 QUALITY ASSURANCE

Notify the Owner’s Representative at least 48 hours before concrete placement so that reinforcement may be inspected, and errors corrected, without delaying Work.

PART 2 P R O D U C T S

2.01 MATERIAL

Reinforcing Bars: Deformed bars conforming to ASTM A615, grade as indicated on Drawings, except column spirals and those shown on Drawings to be smooth bars. Where grade is not shown on Drawings, use Grade 60.

Smooth Bars: Where indicated on Drawings, use smooth bars conforming to ASTM A36; ASTM A615, Grade 60; or ASTM A675, Grade 70.

Column Spirals: Bars conforming to ASTM A615, Grade 60, or wire conforming to ASTM A82.

Epoxy-Coated Deformed Bars, Column Spirals and Smooth Bars: Conform to ASTM A775/A775M.

Welded Wire Fabric:

1. Welded Smooth Wire Fabric: Conform to ASTM A185.

2. Welded Deformed Wire Fabric: Conform to ASTM A497.

3. Provide wire size, type and spacing as shown. Where type is not shown on Drawings, use welded smooth wire fabric.

4. Furnish welded wire fabric in flat sheets only.

Tie Wire: 16-1/2 gage or heavier annealed steel wire. Use plastic-coated tie wire with epoxy-coated reinforcing steel.

Bar Supports: Provide chairs, riser bars, ties and other accessories made of plastic or metal, except as otherwise specified. Use bar supports and accessories of sizes required to provide required concrete cover. Where concrete surfaces are exposed to weather, water or wastewater, provide plastic accessories only; do not use galvanized or plastic-tipped metal in such locations. Provide metal bar supports and accessories rated Class 1 or 2 conforming to CRSI MSP-1 Manual of Standard Practice. Use epoxy-coated bar supports with epoxy-coated reinforcing bars.

Slabs on Grade: Provide chairs with sheet metal bases or provide precast concrete bar supports 3 inches wide, 6 inches long, and thick enough to allow required cover. Embed tie wires in 3-inch by 6-inch side.

Mechanical Bar Splices:

5. Conform to ACI 318; use where indicated on Drawings.

   a. Compression splices shall develop ultimate stress of reinforcing bar.

   b. Tension splices shall develop 125 percent of minimum yield point stress of reinforcing bar.

6. Regardless of chemical composition of steel, any heat effect shall not adversely affect performance of reinforcing bar.

Welded Splices:

7. Provide welded splices where shown and where approved by the Owner's Representative. Welded splices of reinforcing steel shall develop a tensile strength exceeding 125 percent of the yield strength of the reinforcing bars connected.

8. Provide materials for welded splices conforming to AWS D1.4.

Epoxy Grout: High-strength rigid epoxy adhesive, conforming to ASTM C881, Type IV, manufactured for purpose of anchoring dowels into hardened concrete and the moisture condition, application temperature and orientation of the hole to be filled. Unless otherwise shown, depth of embedment shall be as required to develop the full tensile strength (125 percent of yield strength) of dowel, but not less than 12 diameters.

2.02 FABRICATION

Bending: Fabricate bars to shapes indicated on Drawings by cold bending. Bends shall conform to minimum bend diameters specified in ACI 318. Do not straighten or rebend bars. Fabricate epoxy-coated reinforcing steel to required shapes in a manner that will not damage epoxy coating. Repair any damaged epoxy coating with patching material conforming to Item 4.4 of ASTM A775/A775M.
Splices:

1. Locate splices as indicated on Drawings. Do not locate splices at other locations without approval of the Owner's Representative. Use minimum number of splices located at points of minimum stress. Stagger splices in adjacent bars.

2. Length of lap splices: As shown on Drawings.

3. Prepare ends of bars at mechanical splices in accordance with splice manufacturer's requirements.

Construction Joints: Unless otherwise shown, continue reinforcing through construction joints.
Bar Fabrication Tolerances: Conform to tolerances listed in ACI 315, Figures 4 and 5.
Standard Hooks: Conform to the requirements of ACI 318.
Marking: Clearly mark bars with waterproof tags showing number of bars, size, mark, length and yield strength. Mark steel with same designation as member in which it occurs.

PART 3 E X E C U T I O N

3.01 PREPARATION

Clean reinforcement of scale, loose or flaky rust and other foreign material, including oil, mud or coating that will reduce bond to concrete.

3.02 INSTALLATION

Placement Tolerances: Place reinforcement within tolerances of Table 03210A at the end of this Section. Bend tie wire away from forms to maintain the specified concrete coverage.
Interferences: Maintain 2-inch clearance from embedded items. Where reinforcing interferes with location of other reinforcing steel, conduit or embedded items, bars may be moved within specified tolerances or one bar diameter, whichever is greater. Where greater movement of bars is required to avoid interference, notify the Owner's Representative. Do not cut reinforcement to install inserts, conduit, mechanical openings or other items without approval of the Owner's Representative.
Concrete Cover: Provide clear cover measured from reinforcement to face of concrete as listed in Table 03210B at the end of this Section, unless otherwise indicated on Drawings.

Placement in Forms: Use spacers, chairs, wire ties and other accessory items necessary to assemble, space and support reinforcing properly. Provide accessories of sufficient number, size and strength to prevent deflection or displacement of reinforcement due to construction loads or concrete placement. Use appropriate accessories to position and support bolts, anchors and other embedded items. Tie reinforcing bars at each intersection, and to accessories. Blocking reinforcement with concrete or masonry is prohibited.

Placement for Concrete on Ground: Support bar and wire reinforcement on chairs spaced at approximately 3 feet on centers each way. Use minimum of one support for each 9 square feet. Tie supports to reinforcing bars and wires.

Vertical Reinforcement in Columns: Offset vertical bars by at least one bar diameter at splices. Provide accurate templates for column dowels to ensure proper placement.

Splices:

1. Do not splice bars, except at locations indicated on Drawings or reviewed shop drawings, without approval of the Owner's Representative.

2. Lap Splices: Unless otherwise shown or noted, Class B, conforming to ACI 318-89, Section 12.15.1. Tie securely with wire prior to concrete placement, to prevent displacement of splices during concrete placement.

3. Mechanical Bar Splices: Use only where indicated on Drawings or approved by the Owner's Representative. Install in accordance with manufacturer's instructions.

    a. Couplers located at a joint face shall be of a type which can be set either flush or recessed from the face as shown. Seal couplers prior to concrete placement to completely eliminate concrete or cement paste from entering.

    b. Couplers intended for future connections: Recess 1/2 inch minimum from concrete surface. After concrete is placed, plug coupler and fill recess with sealant to prevent contact with water or other corrosive materials.

    c. Unless noted otherwise, match mechanical coupler spacing and capacity to that shown for the adjacent reinforcing.

Construction Joints: Place reinforcing continuous through construction joints, unless noted otherwise.

Welded Wire Fabric: Install wire fabric in as long lengths as practicable. Unless otherwise indicated on Drawings, lap adjoining pieces at least 6 inches or one full mesh plus 2 inches, whichever is larger. Lace splices with wire. Do not make end laps midway between supporting beams, or directly over beams of continuous

structures. Offset end laps in adjacent widths to prevent continuous laps. Conform to WRI - Manual of Standard Practice for Welded Wire Fabric.

Field Bending: Shape reinforcing bent during construction operations to conform to Drawings. Bars shall be cold-bent; do not heat bars. Closely inspect reinforcing for breaks. When reinforcing is damaged, replace, Cadweld, or otherwise repair, as directed by the Owner's Representative. Do not bend reinforcement after it is embedded in concrete.

Epoxy-coated Reinforcing Steel: Install in accordance with Paragraph 3.02J, Field Bending, and in a manner that will not damage epoxy coating. Repair damaged epoxy coating with patching material as specified in Paragraph 2.02A, Bending.

Field Cutting: Cut reinforcing bars by shearing or sawing. Do not cut bars with cutting torch.

Welding of reinforcing bars is prohibited, except where shown on Drawings.

3.03 GROUTING OF REINFORCING AND DOWEL BARS

Use epoxy grout for anchoring reinforcing and dowel steel to existing concrete in accordance with epoxy manufacturer's instructions. Drill hole not more than 1/4 inch larger than steel bar diameter (including height of deformations for deformed bars) in existing concrete. Just before installation of steel, blow hole clean of all debris using compressed air. Partially fill hole with epoxy, using enough epoxy so when steel bar is inserted, epoxy grout will completely fill hole around bar. Dip end of steel bar in epoxy and twist bar while inserting into partially filled hole.

TABLE 03210A

REINFORCEMENT PLACEMENT TOLERANCES

PLACEMENT	TOLERANCE IN INCHES
Clear Distance -	
To formed soffit:	-1/4
To other formed surfaces:	±1/4
Minimum spacing between bars	-1/4
Clear distance from unformed surface to top reinforcement -	
Members 8 inches deep or less:	±1/4
Members more than 8 inches deep but less than 24 inches deep:	-1/4, +1/2
Members 24 inches deep or greater:	-1/4, +1
Uniform spacing of bars (but the required number of bars shall not be reduced):	±1
Uniform spacing of stirrups and ties (but the required number of stirrups and ties shall not be reduced):	±1
Longitudinal locations of bends and ends of reinforcement -	
General:	±1
Discontinuous ends of members:	±1/2
Length of bar laps:	-1
Embedded length -	
For bar sizes No. 3 through 11:	-1
For bar sizes No. 14 and 18:	-2

TABLE 03210B

MINIMUM CONCRETE COVER FOR REINFORCEMENT

SURFACE	MINIMUM COVER IN INCHES
Slabs and Joists -	
Top and bottom bars for dry conditions -	
No. 14 and No. 18 bars:	1-1/2
No. 11 bars and smaller:	1
Formed concrete surfaces exposed to earth, water or weather; over, or in contact	
with, sewage; and for bottoms bearing on work mat, or slabs supporting earth	
cover -	
No. 5 bars and smaller:	1-1/2
No. 6 through No. 18 bars:	2
Beams and Columns -	
For dry conditions -	
Stirrups, spirals and ties:	1-1/2
Principal reinforcement:	2
Exposed to earth, water, sewage or weather -	
Stirrups and ties:	2
Principal reinforcement:	2-1/2
Walls -	

For dry conditions -	
No. 11 bars and smaller:	1
No. 14 and No. 18 bars:	1-1/2
Formed concrete surfaces exposed to earth, water, sewage or weather, or in contact with ground -	
Circular tanks with ring tension:	2
All others:	2
Footings and Base Slabs -	
At formed surfaces and bottoms bearing on concrete work mat:	2
At unformed surfaces and bottoms in contact with earth:	3
Over top of piles:	2
Top of footings – same as slabs	

END OF SECTION

SECTION 03250

JOINTS IN CONCRETE STRUCTURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Waterstops and similar joints in concrete structures intended to retain water or withstand hydrostatic pressure.

1.02 UNIT PRICES

A. No separate payment will be made for joints under this Section. Include payment in unit price for structural concrete.

1.03 DEFINITIONS

A. The following definitions refer to concrete joints in water-retaining structures. Unless otherwise indicated, all such joints shall have a waterstop or sealant groove to prevent water penetration at the joint.

B. Construction Joint: The joint or surface between two concrete pours, produced by placing fresh concrete in contact with a hardened concrete surface.

1. A bond breaker may or may not be used, as indicated.

2. Reinforcing steel is continuous through the joint, unless otherwise indicated.

C. Contraction Joint: A joint similar to a construction joint, but intended to accommodate concrete shrinkage and similar movement.

1. A bond breaker is always used.

2. Reinforcing steel is held back 4-1/2 inches from the joint surface, and sleeved dowels are used so pours can move apart, unless otherwise indicated.

D. Expansion Joint: A joint similar to a construction or contraction joint, but intended to accommodate both expansion and contraction.

1. Compressible joint filler is placed against the hardened concrete, to form and separate the second pour so pours can move together or apart.

2. A centerbulb waterstop and joint sealant are used to fill the gap, unless otherwise indicated.

3. Reinforcing steel is held back, and sleeved dowels are used to allow and control movement, unless otherwise indicated.

E. Control Joint: A groove cut or formed in the face of a single pour, producing a weaker plane more likely to crack; used in an attempt to control locations of normal shrinkage cracks.

1. Joint sealant is used to fill the groove.

2. Reinforcing steel is continuous, since the pour is monolithic.

1.04 SUBMITTALS

A. Submit under provisions of all provisions and sections of these specifications.

B. Product Data: Information sufficient to indicate compliance with Contract Documents, including manufacturer's descriptive literature and specifications.

C. Shop Drawings: Indicate type, size and location of each joint in each structure, and installation details.

D. Samples: For extrusions, submit 6-inch lengths. For molded or fabricated items, submit whole items. Submit 6-inch beads for sealants and 6-inch square samples for coatings, on appropriate substrates.

E. Quality Control Submittals: Submit manufacturer's instructions and recommendations for storage, handling and installation including material safety data sheets, and, where specified, test reports certified by an independent testing laboratory or the manufacturer, and manufacturer's certification that products furnished comply with Contract Documents.

1.05 QUALITY ASSURANCE

A. Waterstop Inspection: Notify the Owner’s Representative to schedule inspection at least 24 hours prior to work involving waterstop installation or fabrication of waterstop field joints.

B. Defects include but are not limited to the following:

1. Offsets at joints greater at any point than 1/16 inch or 15 percent of material thickness, whichever is less.

2. Exterior cracks at joints due to incomplete bond, which are deeper at any point than 1/16 inch or 15 percent of material thickness, whichever is less.

3. At any point, any combination of offsets or exterior cracks resulting in a net reduction in the cross-sectional area of the waterstop greater than 1/16 inch or 15 percent of material thickness at any point, whichever is less.

4. Misalignment of joint resulting in misalignment of the waterstop in excess of 1/2 inch in 10 feet.

5. Porosity in the welded joint as evidenced by visual inspection.

6. Bubbles or inadequate bond which can be detected with a penknife. If, while probing the joint with the point of a penknife, the knife breaks through the outer portion of the weld into a bubble, the joint is defective.

C. Field Joint Samples: Prior to use of the waterstop material in the field, fabricate and submit for review a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used. Fabricate samples so material and workmanship represent fittings to be furnished. Field samples of fabricated fittings (crosses, tees, etc.) will be selected at random by the Owner for testing by a laboratory at Owner's expense; they shall have a tensile strength across the joints equal to at least 600 psi when tested in accordance with ASTM D638. Contractor shall pay cost of failed tests and retesting required by failures.

D. Construction Joint Sealant: Prepare adhesion and cohesion test specimens, as specified, at intervals of 5 working days while sealants are being installed.

E. Sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

1. Prepare sealant specimen between 2 concrete blocks (1 inch by 2 inches by 3 inches); spacing between the blocks shall be 1 inch. Use coated spacers (2 inches by 1-1/2 inches by 1/2 inch) to ensure sealant cross-sections of 1/2 inch by 2 inches with a width of 1 inch.

2. Cast and cure sealant according to manufacturer's recommendations except that curing period shall be not less than 24 hours.

3. Following curing period, widen the gap between blocks to 1-1/2 inches. Use spacers to maintain this gap for 24 hours prior to inspection for failure.

F. Sealant Installer: A competent waterproofing specialty contractor, approved by sealant manufacturer, having a record of successful performance in similar installations. Before beginning work, sealant manufacturer's representative shall instruct installer's crew in proper method of application.

1.06 WARRANTY

A. Provide a written warranty covering entire sealant installation against faulty and incompatible materials and workmanship, and agreeing to repair or replace defective work at no additional cost to the Owner, for a period of 5 years.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials in accordance with manufacturer's printed instructions.

B. Store waterstops to permit free circulation of air around waterstop material.

PART 2 P R O D U C T S

2.01 EPA POTABLE CLASSIFICATION

A. All joint materials shall be materials that reach acceptability for use in potable water systems no later than 30 days after installation, as classified by the Environmental Protection Agency.

2.02 PVC WATERSTOPS

A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that the material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.

B. Flat Strip and Center-Bulb Waterstops: As detailed, and as manufactured by: Kirkhill Rubber Co., Brea, California; Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal acceptable to the Owner’s Representative, provided that at no place shall waterstop thickness be less than 3/8 inch.

C. Multi-Rib Waterstops: As detailed, and as manufactured by Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal acceptable to the Owner’s Representative. Use prefabricated joint fittings at intersections of ribbed-type waterstops.

D. Other Waterstops: When types of waterstops not listed above are indicated on the Drawings, they are subject to these specifications.

E. Waterstop Properties: When tested in accordance with specified standards, waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	Value	ASTM Standard
Tensile Strength-min (psi):	1750	D638, Type IV
Ultimate Elongation-min (percent):	350	D638, Type IV
Low Temp Brittleness-max (degrees F):	-35	D746
Stiffness in Flexure-min (psi):	400	D747
Accelerated Extraction (CRD-C572) -		
Tensile Strength-min (psi):	1500	D638, Type IV
Ultimate Elongation-min (percent):	300	D638, Type IV
Effect of Alkalies (CRD-C572) -		
Change in Weight (percent):	+0.25/-0.10	------
Change in Durometer, Shore A:	+5	D2240
Finished Waterstop -		
Tensile Strength-min (psi):	1400	D638, Type IV
Ultimate Elongation-min (percent):	280	D638, Type IV

2.03 JOINT SEALANT

A. Material: Polyurethane polymer designed for bonding to concrete which is continuously submerged in water. Use no material with an unsatisfactory history of bond or durability when used in joints of liquid-retaining structures.

B. Sealant Properties at 73 degrees F, 50 percent relative humidity:

Work Life:	45 - 180 minutes
Time to Reach 20 Shore A Hardness	

(at 77 degrees F, 200 gr quantity):	24 hours, maximum
Ultimate Hardness (ASTM D2240):	20 - 45 Shore A
Tensile Strength (ASTM D412):	200 psi, minimum
Ultimate Elongation (ASTM D412):	400 percent, minimum
Tear Resistance (Die C ASTM D624):	75 pounds per inch of thickness, minimum
Color:	Light Gray

C. Polyurethane Sealants for Waterstop Joints in Concrete:

1. Sealant: 2-part polyurethane; when cured, sealant shall meet or exceed ANSI/ASTM C920 or Federal Specification TT-S-0227 E(3) for 2-part material.

2. Vertical and overhead horizontal joints: Use only "non-sag" compounds meeting ANSI/ASTM C920, Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.

3. Plane horizontal joints: Self-leveling compounds meeting ANSI/ASTM C920, Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I. For joints subject to either pedestrian or vehicular traffic, use a compound providing non-tracking characteristics and having a Shore A hardness range of 35 to 45.

4. Primer: Use only compatible materials manufactured or recommended for the application by the sealant manufacturer, in accordance with the printed instructions and recommendations of the sealant manufacturer.

D. Acceptable Products: Polymeric Systems Inc. "PSI-270"; Pacific Polymers "Elastothane 227R"; Sika Corporation "Sikaflex 2C", or equal acceptable to the Owner’s Representative.

E. Sealants for non-waterstop joints: Conform to Section 07920 - Sealants and Caulking.

2.04 MISCELLANEOUS MATERIALS

A. Bearing Pad: ASTM D2000 neoprene, Grade 2 or 3, Type BC, tensile strength 1450 psi, 60 durometer hardness, unless otherwise indicated.

B. Neoprene Sponge: ASTM D1056, Type 2C3-E1 closed-cell expanded neoprene.

C. Preformed Joint Filler: ASTM D1752 Type I non-extruding type; neoprene sponge or polyurethane of firm texture, except as otherwise specified. Bituminous fiber type will not be permitted.

D. Control Joint Former: Continuous plastic insert strips with anchorage ribs located at the bottom and an enlarged upper portion that is readily removable without damage to the concrete, and is sized to form sealant groove. Size to extend to at least 1/4 slab depth.

E. Backing Rod: Extruded closed-cell polyethylene foam rod, compatible with joint sealant materials used, with a tensile strength not less than 40 psi, and compression deflection approximately 25 percent at 8 psi. Size: 1/8-inch larger in diameter than joint width, except use one-inch diameter rod for 3/4-inch wide joints.

F. Bond Breaker: "Super Bond Breaker" manufactured by Burke Company, San Mateo, California; "Select Cure CRB", manufactured by Select Products Co., Upland, California, or equal acceptable to the Owner's Representative. Bond breaker shall contain a fugitive dye so areas of application will be readily distinguishable.

G. Slip Dowels: Smooth epoxy-coated bars conforming to ASTM A775.

H. PVC Tubing: ASTM D2241, Schedule SDR 13.5.

2.05 RESILIENT WATERSTOP

A. Resilient waterstop, where called for on the Drawings, shall be either a bentonite or adhesive type material.

B. Bentonite Waterstop:

1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.

2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.

3. Cross-sectional dimensions, unexpanded waterstop: One inch by 3/4 inch.

4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.

C. Adhesive Waterstop:

1. Adhesive waterstop shall be at least 2 inches in diameter and shall be Synko-Flex preformed plastic adhesive waterstop by Synko-Flex Products, Inc., or

equal. The waterstop shall meet or exceed requirements of Federal Specification SS-S-210A.

2. The adhesive waterstop shall be supplied wrapped completely by a two part protective paper.

3. The adhesive waterstop material shall have independent laboratory tests verifying that the material seals joints in concrete against leakage when subjected to a minimum of 30 psi water pressure for at least 72 hours.

4. Primer, to be used on hardened concrete surfaces, shall be provided by the same manufacturer as the waterstop material.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for the extent of the joint; make splices necessary to provide such continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.

B. Install waterstops in concrete on one side of joints, leaving other side exposed until the next pour. When a waterstop will remain exposed for 2 days or more, shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.02 SPLICES IN WATERSTOPS

A. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.

1. Do not damage material by heat sealing.

2. Splice tensile strength: At least 60 percent of unspliced material tensile strength.

3. Maintain continuity of waterstop ribs and tubular center axis.

B. Butt end-to-end joints of 2 identical waterstop sections may be made in the forms during placement of waterstop material.

C. Prior to placement in formwork, prefabricate all waterstop joints involving more than 2 ends to be joined together, an angle cut, an alignment change, or the joining of 2 dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the Owner’s

Representative, install prefabricated waterstop joint assemblies in formwork, and butt-weld ends of the 24-inch strips to the straight-run portions of waterstop in the forms.

D. Where a center bulb waterstop intersects and is joined to a non-center bulb waterstop, take care to seal the end of the center bulb, using additional PVC material if needed.

3.03 JOINT CONSTRUCTION

A. Setting Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.

2. Flat-strip waterstop: Prevent folding over by concrete during placement. Unless otherwise shown, hold waterstops in place with wire ties on 12-inch centers passed through the waterstop edge and tied to reinforcing steel.

    a. Horizontal waterstops (with flat face in vertical plane): Hold in place by fastening upper waterstop edge to continuous supports.

    b. Horizontal waterstops (with flat face in horizontal plane): Work concrete under waterstops by hand to eliminate air and rock pockets.

3. Place center bulb waterstops in expansion joints centered on joint filler material.

4. Where a waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to a waterstop in a future concrete placement, terminate the waterstop 6 inches below the top of the wall.

B. Joint Location: Unless specifically noted otherwise, provide construction joints at 25-foot maximum spacing for concrete construction. Where joints are shown spaced greater than 40 feet apart, provide additional joints to maintain the 25-foot maximum spacing. Submit joint locations for review by the Owner's Representative.

C. Joint Preparation: Prepare surfaces in accordance with Section 03310 - Structural Concrete. Unless otherwise indicated, bonding is required at horizontal concrete joints in walls. Except on horizontal wall construction joints, wall-to-slab joints, or where otherwise shown or specified, at joints where waterstops are required, coat the joint face of the first pour with bond breaker as specified.

D. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Contract Documents.

E. Construction Joint Sealant:

1. In water-bearing floor slabs and elsewhere where indicated, provide construction joints with tapered grooves filled with construction joint sealant. Leave groove- forming material in place until time grooves are cleaned and filled with joint sealant. After removing groove forms, remove laitance and fins and sandblast the grooves. Allow grooves to dry thoroughly, then blow out, immediately prime surfaces, place bond-breaker tape in bottom of groove and fill with construction joint sealant. Use no sealant without a primer. Completely fill sealant grooves. Thoroughly clean areas designated to receive sealant, as specified for tapered grooves, prior to sealant application.

2. Mix and install primer and sealant in accordance with manufacturer's printed instructions and recommendations. Do not coat sides of sealant groove with bond breaker, curing compound or other substance which would interfere with proper sealant bond. Allow at least 7 days for sealant to achieve final cure before filling structure with water.

3. Thoroughly and uniformly mix 2-part catalyst-cured material.

4. Remove and replace improperly cured sealants after the manufacturer's recommended curing time; thoroughly sandblast the groove to remove all traces of uncured or partially-cured sealant and primer, then re-prime and re-seal with specified sealant.

F. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations except as otherwise indicated and specified.

2. When requested by the Owner’s Representative, provide technical assistance by manufacturer's representative in the field at no additional cost to the Owner.

3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.

4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop a minimum of 6 inches and place in contact with the PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form a smooth joining surface.

5. At the free top of walls without connecting slabs, stop the resilient waterstop and grooves (where used) 6 inches from the top in vertical wall joints.

6. Bentonite Waterstop:

7. Locate bentonite waterstop as near as possible to the center of the joint and extend continuous around the entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.

    a. Where thickness of the concrete member to be placed on the bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1-1/4 inches wide formed or ground into the concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.

    b. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm the material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.

    c. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth if necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using an epoxy grout which completely fills voids and irregularities beneath the waterstop material. Prior to installation, wire brush the concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.

    d. In addition to the adhesive backing provided with the waterstop, secure bentonite waterstop in place with concrete nails and washers at 12-inch maximum spacing.

8. Adhesive Waterstop:

    a. Thoroughly clean the concrete surface on which the waterstop is to be placed with a wire brush and coat with primer.

    b. If the surface is too rough to allow the waterstop to form a complete contact, grind to form an adequately smooth surface.

    c. Install the waterstop with the top protective paper left in place. Overlap joints between strips a minimum of 1 inch and cover back over with the protective paper.

d. Do not remove protective paper until just before final formwork completion. Concrete shall be placed immediately. The time that the waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

G. Control Joints:

1. Where indicated, form in slabs by sawcutting, preformed plastic inserts or other means acceptable to the Owner's Representative. Minimum insert or sawcut: 1/4 slab depth.

2. Perform sawcutting during the curing period as soon as possible after concrete has reached its final set, has attained sufficient strength to support sawcutting operations without damage, and while it remains fully saturated.

3. Leave the removable portion of plastic inserts in place and protect sawcuts against damage and intrusion of foreign material until the end of the curing period and until concrete has dried sufficiently to allow sealant installation.

4. Sealant Installation: Blow foreign material from formed or sawcut space. Insert a foam backer rod to form a sealant depth equal to the width of the space but not less than 3/8 inch. Install sealant as specified elsewhere in the Contract Documents.

END OF SECTION

SECTION 03310

STRUCTURAL CONCRETE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cast-in-place normal-weight structural concrete and mass concrete.

1.02 UNIT PRICES

A. Measurement for structural concrete is on lump-sum basis for each structure as bid. Payment includes related work performed on these structures in accordance with related sections of these Specifications.

B. Measurement for extra structural concrete is on cubic-yard basis. Payment includes related work performed in accordance with related sections.

1.03 DEFINITIONS

A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

B. Hot Weather: Any combination of high air temperature, low relative humidity and wind velocity tending to impair quality of fresh or hardened concrete or otherwise resulting in abnormal properties.

C. Cold Weather: Period when, for more than 2 successive days, mean daily temperature is below 40 degrees F.

1.04 SUBMITTALS

A. Conform to all provisions and sections of these specifications.

B. Mill Certificates: Required for bulk cement.

C. Design Mixes:

1. Submit test data on proposed design mixes for each type of concrete in the Work, including each class, and variations in type, source or quantity of material. Include type, brand and amount of cementitious materials; type, brand and amount of each admixture; slump; air content; aggregate sources, gradations, specific gravity and absorption; total water (including moisture in aggregate); water/cement ratio; compressive strength test results for 7 and 28

days; and shrinkage tests for Class C and D concrete at 21 or 28 days of drying.

2. Submit abrasion loss and soundness test results for limestone aggregate.

3. Testing of aggregates, including sieve analysis, shall be performed by a certified independent testing laboratory. Tests shall have been performed no earlier than 3 months before Notice to Proceed.

4. Provide standard deviation data for plant producing concrete. Data shall include copies of laboratory test results and standard deviation calculated in accordance with ACI 318, Item 5.3.1. Laboratory tests shall have been performed within past 12 months. When standard deviation data is not available, comply with ACI 318, Table 5.3.2.2.

5. Review and acceptance of mix design does not relieve Contractor of responsibility to provide concrete of quality and strength required by these Specifications.

D. Admixtures: Submit manufacturer's technical information, including following:

1. Air-Entraining Admixture: Give requirements to control air content under all conditions, including temperature variations and presence of other admixtures.

2. Chemical Admixtures: Give requirements for quantities and types to be used under various temperatures and job conditions to produce uniform, workable concrete mix. Submit evidence of compatibility with other admixtures and cementitious materials proposed for use in design mix.

E. High-Range Water Reducer (Superplasticizer): When proposed for use, submit manufacturer's technical information and instructions for use of superplasticizer. State whether superplasticizer will be added at ready-mix plant or job site. When superplasticizer will be added at job site, submit proposed plan for measuring and adding superplasticizer to concrete mix at job site, and establish dosing area on site with holding tanks and metering devices. When superplasticizer is to be added at ready-mix plant, submit contingency plans for adding additional superplasticizer at job site when required due to delay in placing concrete. Identify portions of Work on which superplasticizer is proposed for use.

F. Hot and Cold Weather Concreting: Submit, when applicable, proposed plans for hot and cold weather concreting. Review and acceptance of proposed procedure will not relieve Contractor of responsibility for quality of finished product.

G. Project Record Drawings: Accurately record actual locations of embedded utilities and components which are concealed from view.

1.05 QUALITY ASSURANCE

A. Provide necessary controls during evaluation of materials, mix designs, production and delivery of concrete, placement and compaction to assure that the Work will be accomplished in accordance with Contract Documents. Maintain records of concrete placement. Record dates, locations, quantities, air temperatures, and test samples taken.

B. Code Requirements: Concrete construction for buildings shall conform to ACI 318. Concrete construction for water and wastewater treatment and conveying structures shall conform to ACI 318 with modifications by ACI 350R, Item 2.6. Where this Specification conflicts with ACI 318 or ACI 350R, this Specification governs.

C. Testing and Other Quality Control Services:

1. Concrete testing required in this section, except concrete mix design, limestone aggregate test data, and testing of deficient concrete, will be performed by an independent commercial testing laboratory employed and paid by the Owner in accordance with Section 01410 - Testing Laboratory Services.

2. Provide material for and cooperate fully with Owner's testing laboratory technician in obtaining samples for required tests.

3. Standard Services: The following testing and quality control services will be provided by Owner in accordance with Section 01410, Testing Laboratory Services:

a. Verification that plant equipment and facilities conform to NRMCA "Certification of Ready-Mix Concrete Production Facilities".

b. Testing of proposed materials for compliance with this Specification.

c. Review of proposed mix design submitted by Contractor.

d. Obtaining production samples of materials at plants or stockpiles during work progress and testing for compliance with this Specification.

e. Strength testing of concrete according to following procedures:

(1). Obtaining samples for field test cylinders from every 100 cubic yards and any portion less than 100 cubic yards for each mix design placed each day, according to ASTM C172, with each sample obtained from a different batch of concrete on a

representative, random basis. Selecting test batches by any means other than random numbers chosen before concrete placement begins is not allowed.

(2). Molding four specimens from each sample according to ASTM C31, and curing under standard moisture and temperature conditions as specified in Sections 7(a) and (b) of ASTM C31.

(3). Testing two specimens at 7 days and two specimens at 28 days according to ASTM C39, reporting test results averaging strengths of two specimens. However, when one specimen evidences improper sampling, molding or testing, it will be discarded and remaining cylinder considered test result. When high-early-strength concrete is used, specimens will be tested at 3 and 7 days.

f. Air content: For each strength test, determination of air content of normal weight concrete according to ASTM C231.

g. Slump: For each strength test, and whenever consistency of concrete appears to vary, conducting slump test in accordance with ASTM C143.

h. Temperature: For each strength test, checking concrete temperature in accordance with ASTM C1064.

i. Lightweight concrete: For each strength test, or more frequently when requested by the Owner's Representative, determination of air content by ASTM C567 and unit weight by ASTM C567.

j. Monitoring of current and forecasted climatic conditions to determine when rate of evaporation, as determined by Figure 2.1.5 of ACI 305R, will produce loss of 0.2 pounds of water, or more, per square foot per hour. Testing lab representative will advise Contractor to use hot weather precautions when such conditions will exist during concrete placement, and note on concrete test reports when Contractor has been advised that hot weather conditions will exist.

k. Class A and D Concrete Shrinkage Tests: Performance of drying shrinkage tests for trial batches as follows:

(1). Preparation and Testing of Specimens: Compression and drying shrinkage test specimens will be taken in each case from the same concrete sample; shrinkage tests will be considered a part of the normal compression tests for the project. 4-inch by

4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C157, modified as follows:

(2). Wet curing: Remove specimens from molds at an age of 23 hours 1 hour after trial batching and immediately immerse in water at 70 degrees F 3 degrees F for at least 30 minutes;

(a). Measure within 30 minutes after first 30 minutes of immersion to determine original length (not to be confused with "base length");

(b). Then submerge in saturated limewater, at 73 degrees F 3 degrees F, for 7 days;

(c). Then measure at age 7 days to establish "base length" for drying shrinkage calculations ("zero" days drying age);

(d). Calculate expansion (base length expressed as a percentage of original length);

(e). Immediately store specimens in a temperature- and humidity-controlled room maintained at 73 degrees F, +3 degrees F and 50 percent +4 percent relative humidity, for the remainder of the test.

(f). Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (initial length of specimen when created) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage.

(g). Report shrinkage separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

4. Additional Testing and Quality Control Services: The following will be performed by an independent commercial testing laboratory employed and

paid by the Owner in accordance with Section 01410, Testing Laboratory Services, when requested by the Owner's Representative.

a. Checking of batching and mixing operations.

b. Review of manufacturer's report of each cement shipment and conducting laboratory tests of cement.

c. Molding and testing reserve 7-day cylinders or field cylinders.

d. Conducting additional field tests for slump, concrete temperature and ambient temperature.

e. Alkalinity Tests: For concrete used in sanitary structures, one test for each structure. Perform alkalinity tests on concrete covering reinforcing steel on the inside of the pipe or structure in accordance with "Encyclopedia of Industrial Chemical Analysis," Vol. 15, page 230.

5. Contractor shall provide the following testing and quality control services:

a. Employ an independent commercial testing laboratory, acceptable to Owner, to prepare and test design mix for each class of concrete for which material source has been changed.

b. Notify commercial testing laboratory employed by Owner 24 hours prior to placing concrete.

6. Testing of deficient concrete in place:

a. When averages of three consecutive strength test results fail to equal or exceed specified strength, or when any individual strength test result falls below specified strength by more than 500 psi, strength of concrete shall be considered potentially deficient and core testing, structural analysis or load testing may be required by the Owner's Representative.

b. When concrete in place proves to be deficient, Contractor shall pay costs, including costs due to delays, incurred in providing additional testing and analysis services provided by the Owner's Representative, or the independent commercial testing laboratory selected by the Owner.

c. Replace concrete work judged inadequate by core tests, structural analysis or load tests at no additional cost to the Owner.

d. Core Tests:

(1). Obtain and test cores in accordance with ASTM C42. Where concrete in structure will be dry under service conditions, air-dry cores (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for 7 days before test; test dry. Where concrete in structure will be more than superficially wet under service conditions, test cores after moisture conditioning in accordance with ASTM C42.

(2). Take at least three representative cores from each member or area of concrete in place that is considered potentially deficient. Location of cores shall be determined by the Owner's Representative so as to least impair strength of structure. When, before testing, one or more cores shows evidence of having been damaged during or after removal from structure, replace the damaged cores.

(3). Concrete in area represented by core test will be considered adequate when average strength of cores is equal to at least 85 percent of specified strength, and when no single core is less than 75 percent of specified strength.

(4). Patch core holes in accordance with Section 03345 - Concrete Finishing.

e. Structural Analysis: When core tests are inconclusive or impractical to obtain, the Owner's Representative may perform additional structural analysis at Contractor's expense to confirm safety of structure.

f. Load Tests: When core tests and structural analysis do not confirm safety of structure, load tests may be required, and their results evaluated, in accordance with ACI 318.

g. Testing by impact hammer, sonoscope, probe penetration tests (Windsor probe), or other nondestructive device may be permitted by the Owner's Representative to determine relative strengths at various locations in structure, to evaluate concrete strength in place, or for selecting areas to be cored. However, such tests, unless properly calibrated and correlated with other test data, shall not be used as basis for acceptance or rejection of structure's safety.

1.06 STORAGE AND HANDLING OF MATERIALS

A. Cement: Store cement in weathertight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set. When there is any doubt as to expansive potential of shrinkage-compensating cements because of method or length of storage and exposure, laboratory test cement before use.

B. Aggregate: Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3 feet in thickness. Complete each layer before next is started.

C. Fine Aggregate: Before using, allow fine aggregate to drain until uniform moisture content is reached.

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

E. Lightweight Aggregates: Uniformly predampen lightweight aggregates as necessary to prevent excessive variations in moisture content. Allow predampened aggregates to remain in stockpiles, under continuous fog spray, for minimum of 24 hours before use. Provide adequate drainage in stockpile areas to eliminate excess water and accumulation of contaminated fines.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Cement:

1. Use same brand of cement used in concrete mix design. Use only one brand of each type in each structure, unless otherwise indicated on Drawings.

2. Portland Cement: ASTM C150, Type I or Type II, gray in color. Use Type III only when specifically authorized by the Owner's Representative in writing. Use Type II, including the requirements of Table 2, in construction of liquid-containing structures and cooling towers, unless shown otherwise on Drawings.

B. Admixtures:

1. Do not use calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions.

2. Air-Entraining Admixtures: ASTM C260, compatible with other admixtures used.

3. Chemical Admixtures: Polymer type, nonstaining, chloride-free admixtures conforming to ASTM C494, Type A, C, D or E.

4. High-Range Water Reducer (Superplasticizer): ASTM C494, Type F or G, compatible with and by the same manufacturer as other admixtures.

C. Mixing Water: Use clean, potable water, free from harmful amounts of oils, acids, alkalis or other deleterious substances, meeting requirements of ASTM C94.

D. Aggregates: Use coarse aggregate from only one source and fine aggregate from only one source, for exposed concrete in any single structure.

1. Coarse Aggregate: Gravel, crushed gravel or crushed limestone conforming to ASTM C33.

2. Fine Aggregate: Natural sand complying with ASTM C33.

3. Limestone aggregate shall conform to ASTM C33 and the following additional requirements: Clean, hard, strong and durable particles free of chemicals and coatings of silt, clay, or other fine materials that may affect hydration and bond of cement paste. Select crushed limestone: High-calcium limestone (minimum 95 percent $CaCO_3$ and maximum 3.5 percent $MgCO_3$) with maximum Los Angeles Abrasion loss of 38 percent, when tested in accordance with ASTM C131 or ASTM C535. Test aggregate for soundness in accordance with ASTM C88; maximum loss shall not exceed 18 percent after 5 cycles of magnesium sulfate test

4. Maximum size of coarse aggregate:

a. Normal weight concrete, except as noted below: 1-1/2 inches.

b. Formed members 6 inches or less in least dimension: 1/5 least dimension.

c. Slabs: 1/3 depth of slab.

d. Drilled shafts: 1/3 clearance between reinforcing steel, but not greater than 3/4 inch.

e. Concrete fill, seal slabs and bonded concrete topping in clarifiers: 3/8 inch.

5. Coarse aggregate for lightweight concrete: ASTM C330. Grading limits: 3/4 inch to No. 4.

6. Abrasive Aggregate: Conform to requirements of Section 03345 - Concrete Finishing.

E. Calcium Chloride: Not permitted.

F. Evaporation Retardant: Masterbuilders "Confilm", Euclid "Eucobar", or equal.

G. Miscellaneous Materials:

1. Bonding Agent: Two-component modified epoxy resin.

2. Vapor barrier: 6 mil clear polyethylene film of type recommended for below-grade application.

3. Non-shrink grout: premixed compound consisting of non-metallic aggregate, cement and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.02 CONCRETE MIX

A. Objective: Select proportions of ingredients to produce concrete having proper placability, durability, strength, appearance and other specified properties.

B. Mix Design: Employ and pay an independent commercial testing laboratory, acceptable to Owner, to prepare and test mix designs for each type of concrete specified. Proportion mix design ingredients by weight. Submit mix designs and test results for approval.

1. During the trial batches, aggregate proportions may be adjusted by the testing laboratory using two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. Concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. Prepare trial batches using the aggregates, cement and admixtures proposed for the project. Make trial batches large enough to obtain 3 drying shrinkage test specimens and 6 compression test specimens from each batch. Shrinkage testing is required only for Class A and D concrete.

2. Determine compressive strength by testing 6-inch diameter by 12-inch high cylinders, made, cured and tested in accordance with ASTM C192 and ASTM C39. Test 3 compression test cylinders at 7 days and 3 at 28 days. Average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall be not less than 125 percent of the specified compressive strength.

3. Perform sieve analysis of the combined aggregate for each trial batch according to of ASTM C136. Report percentage passing each sieve.

4. In mix designs for Class A and D concrete, fine aggregate shall not exceed 41 percent of total aggregate by weight.

C. Shrinkage Limitations, Class A and D Concrete

1. Maximum concrete shrinkage for specimens cast in the laboratory from the trial batch: 0.036 percent as measured at 21-day drying age, or 0.042 percent at 28-day drying age. Use for construction only mix designs that meet trial batch shrinkage requirements. Shrinkage limitations apply only to Class A and D concrete.

2. Maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

3. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the Owner, for securing the specified shrinkage requirements: Changing the source or aggregates, cement or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or its effects.

D. Selecting Ingredient Proportions for Concrete:

1. Proportion concrete mix according to ACI 301, Chapter 3.

2. Establish concrete mix design by laboratory trial batches prepared by independent testing laboratory, or on basis of previous field experience in accordance with provisions of ACI 318, Item 5.3; however, minimum cement content for each class of concrete shall not be less than specified.

3. Concrete mix design data submitted for review shall have average 28-day compressive strength calculated in accordance with ACI 318, Item 5.3.2.1. When data is not available to determine standard deviation in accordance with ACI 318, Item 5.3.1, average 28-day strength of mix design shall conform to ACI 318, Table 5.3.2.2.

E. Water-Cement Ratios:

1. Maximum allowable water-cement ratios shall be as follows:

a. Concrete for liquid-containing structures: 0.45.

b. Concrete subjected to brackish water, salt spray or deicers: 0.40.

c. All other concrete: 0.55.

2. Superplasticizer may be added to maintain specified maximum water-cement ratios. Include free water in aggregate in water-cement ratio computations.

F. Adjustment of Mix Proportions: After sufficient data becomes available during construction, mix may be adjusted upon approval of the Owner's Representative, in accordance with ACI 318, Item 5.5; however, minimum cement content for each class of concrete shall not be less than specified.

G. Entrained Air: Air-entrain all concrete except drilled shafts. Total air content in accordance with ASTM C173: 4 to 6 percent.

H. Consistency, Workability, and Slump:

1. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce concrete which can be worked properly into place without segregation, and which can be compacted by vibratory methods as specified, to give the desired strength, density, impermeability and smoothness of surface. Change the quantity of water as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. Determine the consistency of the concrete in successive batches by slump tests in accordance with ASTM C 143. Slumps shall be as follows:

Concrete Type	Minimum Slump	Maximum Slump
Portland Cement Concrete:	2"	4"
Concrete to be dosed with superplasticizer:	1"	3"
Normal Weight Concrete after dosing with superplasticizer:	4"	9"

Lightweight Concrete after		
dosing with superplasticizer:	4"	7"
Drilled Shaft Concrete:	4"*	8"

* Minimum slump where drilled shafts are cast in temporary casings: 5 inches.

2. Specified slump shall apply at time when concrete is discharged at job site. Perform slump tests to monitor uniformity and consistency of concrete delivered to job site; however, do not use as basis for mix design. Do not exceed water-cement ratios specified.

I. Admixtures: Proportion admixtures according to manufacturer's recommendations. Use of accelerator is permitted when air temperature is less than 40 degrees F. Use of retarder is permitted when temperature of placed concrete exceeds 65 degrees F.

J. High-Range Water Reducers (Superplasticizers): Use superplasticizer to improve workability of concrete or delay hydration of cement, in accordance with requirements and recommendations of product manufacturer and approved submittals.

K. Concrete Classification and Strength:

1. Strength: Conform to values for class of concrete indicated on Drawings for each portion of Work. Requirements are based on 28-day compressive strength. If high early-strength concrete is allowed, requirements are based on 7-day compressive strength.

2. Classification:

Class (Normal-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per CubicYard

Concrete for Structures Containing Water or Wastewater

A	4000	564 (6 Sacks)
B	1500	329 (3-1/2 Sacks)
C	3000	470 (5 Sacks)
D	5000	658 (7 Sacks)
H	3000	611 (6-1/2 Sacks)

Class (Normal-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per CubicYard
Concrete for Buildings, Slabs on Grade and Miscellaneous Structures		
AB	4000	Not Applicable
BB	1500	Not Applicable
CB	3000	Not Applicable
DB	5000	Not Applicable

Class (Light-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per Cubic Yard
E	3000	Not Applicable
F	4000	Not Applicable
G	5000	Not Applicable

3. Maximum size aggregate for Class H concrete: 3/8 inch. Maximum size aggregate for all other normal-weight concrete: 1-1/2 inches, except as specified in Paragraph 2.01D.4.

4. When required strength is not obtained with minimum cement content as specified, add cement, lower water-cement ratio or provide other aggregates as necessary.

5. In addition to conforming to specified strength, lightweight concrete must be within specified unit weight limits. Maximum air-dry unit weight is 118 pounds per cubic foot; minimum is 110 pounds per cubic foot unless shown otherwise on Drawings. Determine air-dry unit weight in accordance with ASTM C567. Correlate air-dry unit weight with fresh unit weight of the same concrete as a basis for acceptance during construction.

L. Use of Classes of Concrete:

1. Use classes of concrete as indicated on the Drawings and in other specifications.

2. Liquid-containing structures: If not otherwise indicated, use the following classes for structures containing water or wastewater and for utility applications in the locations described:

a. Class A: All reinforced concrete and where not otherwise defined.

b. Class B: Un-reinforced concrete used for plugging pipes, seal slabs, thrust blocks and trench dams, unless indicated otherwise.

c. Class H: Fill and topping. Where concrete fill thickness exceeds 3 inches in the majority of a placement and is not less than 1.5 inches thick, Class A concrete may be used.

3. All other structures: If not otherwise indicated, use the following classes in the locations described:

a. Class AB: All reinforced concrete and where not otherwise defined.

b. Class CB: Duct banks; see section 16402 - Underground Duct Banks for additional requirements.

c. Class BB: Un-reinforced concrete fill under structures.

2.03 MIXING NORMAL WEIGHT CONCRETE

A. Conform to ACI 301, Chapter 7.

B. Ready-Mixed Concrete:

1. Measure, batch, mix and transport ready-mixed concrete according to ASTM C94. Plant equipment and facilities shall conform to NRMCA "Certification of Ready Mixed Concrete Production Facilities".

2. Provide batch tickets with information specified in ASTM C94. Deliver batch ticket with concrete and give to Owner's on-site testing laboratory representative.

C. Admixtures:

1. Charge air-entraining and chemical admixtures into mixer as solution using automatic dispenser or similar metering device. Measure admixture to accuracy within + 3 percent. Do not use admixtures in powdered form.

2. Two or more admixtures may be used in same concrete, provided that admixtures in combination retain full efficiency and have no deleterious effect on concrete or on properties of each other. Inject admixtures separately during batching sequence.

3. Add retarding admixtures as soon as practicable after addition of cement.

D. Temperature Control:

1. When ambient temperature falls below 40 degrees F, keep as-mixed temperature above 55 degrees F to maintain concrete above minimum placing temperature.

2. When water or aggregate has been heated, combine water with aggregate in mixer before cement is added. Do not add cement to mixtures of water and aggregate when temperature of mixture is greater than 100 degrees F.

3. In hot weather, maintain temperature of concrete below maximum placing temperature. When necessary, temperature may be lowered by cooling ingredients, cooling mixer drum by fog spray, using chilled water or well-crushed ice in whole or part for added water, or arranging delivery sequence so that time of transport and placement does not generate unacceptable temperatures.

4. Submit hot weather and cold weather concreting plans for approval.

2.04 MIXING LIGHTWEIGHT CONCRETE

A. Determining Absorption of Aggregates: Mixing procedures vary according to total absorption by weight of lightweight aggregates. Determine total absorption by weight before predamping in accordance with ASTM C127.

B. Ten Percent or Less Absorption: Follow same requirements as for mixing normal-weight concrete when preparing concrete made with low-absorptive lightweight aggregates having 10 percent or less total absorption by weight. To be low absorptive, aggregates must absorb less than 2 percent additional water in first hour after mixing.

C. More Than 10 Percent Absorption: Batch and mix concrete made with lightweight aggregates having more than 10 percent total absorption by weight, as follows:

1. Place approximately 80 percent of mixing water in mixer.

2. If aggregates are pre-dampened, add air-entraining admixture and all aggregates. Mix for minimum of 30 seconds, or 5 to 10 revolutions of truck mixer.

3. When aggregates have not been predampened, mix aggregates and water for minimum of 1 minute and 30 seconds, or 15 to 30 revolutions of truck mixer. Then add air-entraining admixture and mix for additional 30 seconds.

4. Then, in the following sequence, add specified or permitted admixtures (other than air-entraining agent), all cement, and mixing water previously withheld.

5. Complete mixing using procedures for normal-weight concrete.

2.05 MASS CONCRETE

A. Do not use high early-strength cement (Type III) or accelerating admixtures.

B. Use high-range water-reducing admixture (superplasticizer) to minimize water content and cement content.

C. Specified water-reducing retarding admixture may be required to prevent cold joints when placing large quantities of concrete, to permit revibration of concrete, to offset effects of high temperature in concrete or weather, and to reduce maximum temperature or rapid temperature rise.

2.06 EQUIPMENT

A. Select equipment of size and design to ensure continuous flow of concrete at delivery end. Conform to following equipment and operations requirements.

B. Truck mixers, agitators and manner of operation: Conform to ASTM C94. Use of non-agitating equipment for transporting concrete is not permitted.

C. Belt conveyors: Configure horizontally, or at a slope causing no segregation or loss. Use approved arrangement at discharge end to prevent separation. Discharge long runs without separation into hopper.

D. Chutes: Metal or metal-lined (other than aluminum). Arrange for vertical-to-horizontal slopes not more than 1 to 2 nor less than 1 to 3. Chutes longer than 20 feet or not meeting slope requirements may be used if concrete is discharged into hopper before distribution.

E. Do not use aluminum or aluminum-alloy pipe or chutes for conveying concrete.

PART 3 E X E C U T I O N

3.01 SPECIAL CONSIDERATIONS

A. Concreting Under Water: Not permitted except where shown otherwise on Drawings or approved by the Owner’s Representative. When shown or permitted, deposit concrete under water by methods acceptable to the Owner’s Representative so fresh concrete enters mass of previously placed concrete from within, causing water to be displaced with minimum disturbance at surface of concrete.

B. Protection from Adverse Weather: Unless adequate protection is provided or the Owner’s Representative's approval is obtained, do not place concrete during rain,

sleet, snow or freezing weather. Do not permit rainwater to increase mixing water or to damage surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect Work.

3.02 PREPARATION OF SURFACES FOR CONCRETING

A. Earth Surfaces:

1. Under interior slabs on grade, install vapor barrier. Lap joints at least 6 inches and seal watertight with tape, or sealant applied between overlapping edges and ends. Repair vapor barrier damaged during placement of reinforcing and inserts with vapor barrier material; lap over damaged areas at least 6 inches and seal watertight.

2. Other Earth Surfaces: Thoroughly wet by sprinkling prior to placing concrete, and keep moist by frequent sprinkling up to time of placing concrete thereon. Remove standing water. Surfaces shall be free from standing water, mud and debris at the time of placing concrete.

B. Construction Joints:

1. Definition: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been interrupted so that, in the judgment of the, Owner's Representative new concrete cannot be incorporated integrally with that previously placed.

2. Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, use forms or other means to shape the working face to secure proper union with subsequent work. Make construction joints only where acceptable to the Owner's Representative.

3. Preparation: Give horizontal joint surfaces a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, clean joint surfaces of laitance, loose or defective concrete and foreign material by hydroblasting or sandblasting (exposing aggregate), roughen surface to expose aggregate to a depth of at least 1/4 inch and wash thoroughly. Remove standing water from the construction joint surface before new concrete is placed.

4. After surfaces have been prepared cover approximately horizontal construction joints with a 3-inch lift of a grout mix consisting of Class A concrete batched without coarse aggregate; place and spread grout uniformly. Place wall concrete on the grout mix immediately thereafter.

C. Set and secure reinforcement, anchor bolts, sleeves, inserts and similar embedded items in the forms where indicated on Contract Drawings, shop drawings and as otherwise required. Obtain the Owner's Representative's acceptance before concrete is placed. Accuracy of placement is the sole responsibility of the Contractor.

D. Place no concrete until at least 4 hours after formwork, inserts, embedded items, reinforcement and surface preparation have been completed and accepted by the Owner's Representative. Clean surfaces of forms and embedded items that have become encrusted with grout or previously placed concrete before placing adjacent concrete.

E. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), thoroughly clean and roughen the surface of the old concrete by hydro-blasting or sandblasting (exposing aggregate). Coat joint surface with epoxy bonding agent following manufacturer's written instructions, unless indicated otherwise. Unless noted otherwise, this provision does not apply to vertical wall joints where waterstop is installed.

F. Protection from Water: Place no concrete in any structure until water entering the space to be filled with concrete has been properly cut off or diverted and carried out of the forms, clear of the work. Deposit no concrete underwater. Do not allow still water to rise on any concrete until concrete has attained its initial set. Do not allow water to flow over the surface of any concrete in a manner and at a velocity that will damage the surface finish of the concrete. Pumping, dewatering and other necessary operations for removing ground water, if required, are subject to the Owner's Representative's review.

G. Corrosion Protection: Position and support pipe, conduit, dowels and other ferrous items to be embedded in concrete construction prior to placement of concrete so there is at least a 2 inch clearance between them and any part of the concrete reinforcement. Do not secure such items in position by wiring or welding them to the reinforcement.

H. Where practicable, provide for openings for pipes, inserts for pipe hangers and brackets, and setting of anchors during placing of concrete.

I. Accurately set anchor bolts and maintain in position with templates while they are being embedded in concrete.

J. Cleaning: Immediately before concrete is placed, thoroughly clean dirt, grease, grout, mortar, loose scale, rust and other foreign substances from surfaces of metalwork to be in contact with concrete.

3.03 HANDLING, TRANSPORTING AND PLACING CONCRETE

A. Conform to applicable requirements of Chapter 8 of ACI 301 and this Section. Use no aluminum materials in conveying concrete.

B. Rejected Work: Remove concrete found to be defective or non-conforming in materials or workmanship. Replace rejected concrete with concrete meeting requirements of Contract Documents, at no additional cost to the Owner.

C. Unauthorized Placement: Place no concrete except in the presence of the Owner's Representative. Notify the Owner's Representative in writing at least 24 hours before placement of concrete.

D. Placement in Wall Forms:

1. Do not drop concrete through reinforcing steel.

2. Do not place concrete in any form so as to leave an accumulation of mortar on form surfaces above the concrete.

3. Pump concrete or use hoppers and, if necessary, vertical ducts of canvas, rubber or metal (other than aluminum) for placing concrete in forms so it reaches the place of final deposit without separation. Free fall of concrete shall not exceed 4 feet below the ends of pump hoses, ducts, chutes or buggies. Uniformly distribute concrete during depositing.

4. Do not displace concrete in forms more than 6 feet in horizontal direction from place where it was originally deposited.

5. Deposit in uniform horizontal layers not deeper than 2 feet; take care to avoid inclined layers or inclined construction joints except where required for sloping members.

6. Place each layer while the previous layer is still soft. Rate of placement shall not exceed 5 feet of vertical rise per hour.

7. Provide sufficient illumination in form interior so concrete at places of deposit is visible from the deck or runway.

E. Conveyors and Chutes: Design and arrange ends of chutes, hopper gates and other points of concrete discharge in the conveying, hoisting and placing system so concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyors, if used, shall be of a type acceptable to the Owner's Representative. Do not use chutes longer than 50 feet. Slope chutes so concrete of specified consistency will readily flow. If a conveyor is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyors and chutes shall be covered.

F. Placement of Slabs: In hot or windy weather, conducive to plastic shrinkage cracks, apply evaporation retardant to slab after screeding in accordance with manufacturer's instructions and recommendations. Do not use evaporation retardant to increase water content of the surface cement paste. Place concrete for sloping slabs uniformly from the bottom of the slab to the top, for the full width of the placement. As work progresses, vibrate and carefully work concrete around slab reinforcement. Screed the slab surface in an up-slope direction.

G. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when the air temperature is at or below 40 degrees F and falling. Concrete may be mixed when temperature is 35 degrees F and rising. Take temperature readings in the shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until the concrete has cured for a minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.

When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.

H. No placing concrete when temperature is over

3.04 PUMPING OF CONCRETE

A. If pumped concrete does not produce satisfactory results, in the judgement of the Owner’s Representative, discontinue pumping operations and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment: Use a 2-cylinder pump designed to operate with only one cylinder if one is not functioning, or have a standby pump on site during pumping.

C. The minimum hose (conduit) diameter: Comply with ACI 304.2R.

D. Replace pumping equipment and hoses (conduits) that do not function properly.

E. Do not use aluminum conduits for conveying concrete.

F. Field Control: Take samples for slump, air content and test cylinders at the placement (discharge) end of the line.

3.05 CONCRETE PLACEMENT SEQUENCE

A. Place concrete in a sequence acceptable to the Owner's Representative. To minimize effects of shrinkage, place concrete in units bounded by construction joints shown. Place alternate units so each unit placed has cured at least 7 days for hydraulic structures, or 3 days for other structures, before contiguous unit or units are placed, except do not place corner sections of vertical walls until the 2 adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for other structures.

B. Level the concrete surface whenever a run of concrete is stopped. To ensure straight and level joints on the exposed surface of walls, tack a wood strip at least 3/4-inch thick to the forms on these surfaces. Carry concrete about 1/2 inch above the underside of the strip. About one hour after concrete is placed, remove the strip, level irregularities in the edge formed by the strip with a trowel and remove laitance.

3.06 TAMPING AND VIBRATING

A. Thoroughly settle and compact concrete throughout the entire depth of the layer being consolidated, into a dense, homogeneous mass; fill corners and angles, thoroughly embed reinforcement, eliminate rock pockets and bring only a slight excess of water to the exposed surface of concrete during placement. Use ACI 309R Group 3 immersion-type high-speed power vibrators (8,000 to 12,000 rpm) in sufficient number and with sufficient (at least one) standby units. Use Group 2 vibrators only when accepted by the Owner's Representative for specific locations.

B. Use care in placing concrete around waterstops. Carefully work concrete by rodding and vibrating to make sure air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, work concrete under waterstops by hand, making sure air and rock pockets have been eliminated. Give concrete surrounding the waterstops additional vibration beyond that used for adjacent concrete placement to assure complete embedment of waterstops in concrete.

C. Concrete in Walls: Internally vibrate, ram, stir, or work with suitable appliances, tamping bars, shovels or forked tools until concrete completely fills forms or excavations and closes snugly against all surfaces. Do not place subsequent layers of concrete until previously placed layers have been so worked. Provide vibrators in sufficient numbers, with standby units as required, to accomplish the results specified within 15 minutes after concrete of specified consistency is placed in the forms. Keep vibrating heads from contact with form surfaces. Take care not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.07 PLACING MASS CONCRETE

A. Observe the following additional restrictions when placing mass concrete.

1. Use specified superplasticizer.

2. Maximum temperature of concrete when deposited: 70 degrees F.

3. Place in lifts approximately 18 inches thick. Extend vibrator heads into previously placed layer.

3.08 REPAIRING SURFACE DEFECTS AND FINISHING

A. Conform to Section 03345 - Concrete Finishing.

3.09 CURING

A. Conform to Section 03370 - Concrete Curing.

3.10 PROTECTION

A. Protect concrete against damage until final acceptance by the Owner.

B. Protect fresh concrete from damage due to rain, hail, sleet or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until all components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the Owner's Representative.

END OF SECTION

SECTION 03345

CONCRETE FINISHING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Concrete finishing for structures and basins and includes:

1. Repairing surface defects.

2. Finishing concrete surfaces including both formed and unformed surfaces.

3. Sealing concrete surfaces.

4. Installation of concrete fill and installation of concrete topping in bottoms of clarifiers and thickeners.

B. Section does not cover concrete paving finishing as covered in Section 2521 – Concrete Paving.

1.02 UNIT PRICES

A. No separate payment will be made for concrete finishing under this Section. Include payment in unit price for structural concrete.

1.03 SUBMITTALS

A. Conform to all provisions and sections of these specifications.

B. Submit manufacturer's technical literature on the following products proposed for use. Include manufacturer's installation and application instructions and, where specified, manufacturer's certification of conformance to requirements and suitability for use in the applications indicated.

1. Floor hardener.

2. Sealer.

3. Epoxy floor topping.

4. Epoxy penetrating sealer.

5. Latex bonding agent.

6. Epoxy adhesive.

7. Abrasive aggregate.

8. Evaporation retardant.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Sealer/Dustproofer (VOC Compliant): Water-based acrylic sealer; non-yellowing under ultraviolet light after 200-hour test in accordance with ASTM D4587. Conform to local, state and federal solvent emission requirements.

B. Epoxy Floor Topping: Two-component epoxy resin meeting ASTM C881 Type III, resistant to wear, staining and chemical attack, blended with granite, sand, trap rock or quartz aggregate, trowel-applied over concrete floor. Topping thickness, 1/8 inch; color, gray.

C. Abrasive Aggregate for Non-slip Finish: Fused aluminum oxide grit, or crushed emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Material shall be factory graded, packaged, rustproof and non-glazing, and unaffected by freezing, moisture and cleaning materials.

D. Epoxy Penetrating Sealer: Low-viscosity, two-component epoxy system designed to give maximum penetration into concrete surfaces. Sealer shall completely seal concrete surfaces from penetration of water, oil and chemicals; prevent dusting and deterioration of concrete surfaces caused by heavy traffic; and be capable of adhering to floor surfaces subject to hydrostatic pressure from below. Color, transparent amber or gray; surface, non-slip.

E. Latex Bonding Agent: Non-redispersable latex base liquid conforming to ASTM C1059. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.

F. Bonding Grout: Prepare bonding grout by mixing approximately one part cement to one part fine sand meeting ASTM C144 but with 100 percent passing No. 30 mesh sieve. Mix with water to consistency of thick cream. At Contractor's option, a commercially prepared bonding agent used in accordance with manufacturer's recommendations and instructions may be used. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required. Submit manufacturer's technical information on proposed bonding agent.

G. Patching Mortar:

1. Make patching mortar of same materials and of approximately same proportions as concrete, except omit coarse aggregate. Substitute white Portland cement for part of gray Portland cement on exposed concrete in order to match color of surrounding concrete. Determine color by making trial patch. Use minimum amount of mixing water required for handling and placing. Mix patching mortar in advance and allow to stand. Mix frequently with trowel until it has reached stiffest consistency that will permit placing. Do not add water.

2. Proprietary compounds for adhesion or specially formulated cementitious repair mortars may be used in lieu of or in addition to foregoing patching materials provided that properties of bond and compressive strength meet or exceed the foregoing and color of surrounding concrete can be matched where required. Use such compounds according to manufacturer's recommendations. When used in water and wastewater treatment structures, material shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.

H. Epoxy Adhesive: Two-component, 100 percent solids, 100 percent reactive compound developing 100 percent of strength of concrete, suitable for use on dry or damp surfaces. Epoxy used to inject cracks and as a binder in epoxy mortar shall meet ASTM C881, Type VI. Epoxy used as a bonding agent for fresh concrete shall meet ASTM C881, Type V.

I. Non-shrink Grout: See Section 03600 - Structural Grout.

J. Spray-Applied Coating: Acceptable products are Thoro System Products "Thoroseal Plaster Mix" or equal. Color: Gray.

K. Concrete Topping: Class H concrete with 3/8-inch maximum coarse aggregate size, as specified in Section 03310 - Structural Concrete.

L. Concrete Fill: Class H concrete with 3/8-inch maximum coarse aggregate size, (Class C where fill thickness exceeds 3 inches throughout a placement), as specified in Section 03310 - Structural Concrete.

M. Evaporation Retardant: Confilm, manufactured by Master Builders; Eucobar, manufactured by Euclid Chemical Company; or equal.

PART 3 E X E C U T I O N

3.01 AGGREGATE CONCEALMENT

A. Unless indicated otherwise on Drawings or approved by the Owner's Representative, all surfaces to be finished shall be free of exposed aggregate.

3.02 REPAIRING SURFACE DEFECTS

A. Defective Areas: Repair immediately after removal of forms and obtaining approval by the Owner's Representative. Remove honeycombed and other defective concrete down to sound concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to concrete surface. Thoroughly work bonding grout into the surface with a brush as that the entire surface is covered. Alternatively, a proprietary bonding agent may be used. Use bonding agent in accordance with manufacturer's instructions. While bonding coat is still tacky, apply premixed patching mortar. Thoroughly consolidate mortar into place and strike off to leave patch slightly higher than surrounding surface. To permit initial shrinkage, leave undisturbed for at least 1 hour before final finishing. Keep patched area damp for 7 days. Alternatively, a proprietary cementitious repair mortar may be used and placed in accordance with manufacturer's instructions. Do not use metal tools in finishing patches in formed walls which will be exposed.

B. Tie Holes: Patch holes immediately after removal of forms. After cleaning and roughening with a wire brush on a rotary drill, thoroughly dampen tie hole and fill solid with patching mortar. Taper tie holes shall have the plug, specified in 03100 - Concrete Formwork, driven into the hole to the center of the wall before grouting. Completely fill taper tie holes with patching mortar except that non-shrink grout shall be used for all walls in contact with soil or liquid. On wall faces exposed to view, fill the outer 2 inches of the taper tie hole with patching mortar blended to match adjacent concrete.

C. Cracks: Repair cracks in excess of 0.01 inch by pressure injection of moisture-insensitive epoxy-resin system. Submit proposed material and method of repair for approval by Owner's Representative prior to making repairs.

D. Structural Repair: When required, make structural repairs after prior approval of the Owner's Representative as to method and procedure, using specified epoxy adhesive or approved epoxy mortar.

3.03 FINISHING OF FORMED SURFACES

A. Unfinished Surfaces: Finish is not required on surfaces concealed from view in completed structure by earth, ceilings or similar cover, unless indicated otherwise on Drawings.

B. Rough Form Finish:

1. No form facing material is required on rough form finish surfaces.

2. Patch tie holes and defects. Chip off fins exceeding 1/4 inch in height.

3. Rough form finish may be used on concrete surfaces which will be concealed from view by earth in completed structure, except concealed surfaces required to have smooth form finish, as shown on Drawings.

C. Smooth Form Finish:

1. Form facing shall produce smooth, hard, uniform texture on concrete. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.

2. Patch tie holes and defects. Rub fins and joint marks with wooden blocks to leave smooth, unmarred finished surface.

3. Provide smooth form finish on the wet face of formed surfaces of water-holding structures, and of other formed surfaces not concealed from view by earth in completed structure, except where otherwise indicated on Drawings. Walls that will be exposed after future construction, at locations indicated on Drawings, shall have smooth form finish. Smooth form finish on exterior face of exterior walls shall extend 2 feet below final top of ground elevation. Exterior face of all perimeter grade beams shall have smooth form finish for full depth of grade beam.

D. Rubbed Finish:

1. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.

2. Remove forms as soon as practicable, repair defects, wet surfaces, and rub with No. 16 carborundum stone or similar abrasive. Continue rubbing sufficiently to bring surface paste, remove form marks and fins, and produce smooth, dense surface of uniform color and texture. Do not use cement paste other than that drawn from concrete itself. Spread paste uniformly over surface with brush. Allow paste to reset, then wash surface with clean water.

3. Use rubbed finish at locations indicated on Drawings, except where rubbed finish is indicated for a wall which will be containing a liquid, use spray-applied coating.

E. Spray-applied Coating: At Contractor's option, in lieu of rubbed finish, spray-applied coating may be applied after defects have been repaired and fins removed. Remove form oil, curing compound and other foreign matter that would prevent bonding of coating. Apply coating in uniform texture and color in accordance with coating manufacturer's instructions.

F. Related Unformed Surfaces: Tops of piers, walls, bent caps, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed. Float unformed surfaces to texture reasonably consistent with that of formed surfaces. Continue final treatment on formed surfaces uniformly across unformed surfaces.

G. Provide color and finish uniformity to be determined by the Owner's Representative.

H. Color of concrete pours should be consistent. If not consistent, Contractor shall submit plan for remedying the inconsistency.

3.04 HOT WEATHER FINISHING

A. When hot weather conditions exist, as defined by Section 03310 - Structural Concrete and as judged by the Owner's Representative, apply evaporation retardant to the surfaces of slabs, topping and concrete fill placements immediately after each step in the finishing process has been completed.

3.05 FINISHING SLABS AND SIMILAR FLAT SURFACES TO CLASS A, B AND C TOLERANCES

A. Apply Class A, B and C finishes at locations indicated on Drawings.

B. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. See Section 03100 - Concrete Formwork for edge forms and screeds.

C. Consolidation and Leveling: Concrete to be consolidated shall be as stiff as practicable Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not permit manipulation of surfaces prior to finishing operations.

D. Tolerances for Finished Surfaces: Check tolerances by placing straightedge of specified length anywhere on slab. Gap between slab and straightedge shall not exceed tolerance listed for specified class.

Class	Straightedge Length in Feet	Tolerance in Inches
A	10	1/8

B	10	1/4
C	2	1/4

E. Raked Finish: After concrete has been placed, struck off, consolidated and leveled to Class C tolerance, roughen surface before final set. Roughen with stiff brushes or rakes to depth of approximately 1/4 inch. Notify the Owner's Representative prior to placing concrete requiring initial raked surface finish so that acceptable raked finish standard may be established for project. Protect raked, base-slab finish from contamination until time of topping. Provide raked finish for following:

1. Surfaces to receive bonded concrete topping or fill.

2. Steep ramps, as noted on Drawings.

3. Additional locations as noted on Drawings.

F. Float Finish:

1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.

2. After initial floating, re-check tolerance of surface with 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots to Class B tolerance. Immediately re-float slab to a uniform, smooth, granular texture.

3. Provide float finish at locations not otherwise specified and not otherwise indicated on Drawings.

G. Trowel Finish:

1. Apply float finish as previously specified. After power floating, use power trowel to produce smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional troweling by hand after surface has hardened sufficiently. Do final troweling when ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling operations.

2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to Class A tolerance. On surfaces intended to support floor coverings, remove defects which might show through covering by grinding.

3. Provide trowel finish for floors which will receive floor covering and additional locations indicated on Drawings.

H. Broom or Belt Finish:

1. Apply float finish as previously specified. Immediately after completing floated finish, draw broom or burlap belt across surface to give coarse transverse scored texture.

2. Provide broom or belt finish at locations indicated on Drawings.

3.06 FINISHING SLABS AND SIMILAR FLAT SURFACES TO "F-NUMBER SYSTEM" FINISH

A. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. Edge forms and screeds: Conform to Section 03100 - Concrete Formwork.

B. Consolidation and Leveling: Concrete to be consolidated shall be as dry as practicable. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not manipulate surfaces prior to finishing operations.

C. Tolerances for Finished Surfaces: Owner’s Representative may check floor flatness and levelness in accordance with Paragraph 3.12, Field Quality Control.

D. Float Finish:

1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.

2. Check tolerance of surface after initial floating with a 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low

spots. Immediately refloat slab to uniform, smooth, granular texture to F_F20/F_L17 tolerance, unless shown otherwise on Drawings.

3. Provide "F-Number System" float finish at locations indicated on Drawings.

E. Trowel Finish:

1. Apply float finish as previously specified. After power floating, use power trowel to produce smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional trowelings by hand after surface has hardened sufficiently. Do final troweling when ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling operations.

2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to an F_F25/F_L20 tolerance for slabs on grade and F_F25/F_L17 for elevated slabs, unless shown otherwise on Drawings. On surfaces intended to support floor coverings, remove defects, which might show through covering, by grinding.

3. Provide "F-Number System" trowel finish at locations indicated on Drawings.

3.07 BONDED CONCRETE TOPPING AND FILL

A. Surface Preparation:

1. Protect raked, base-slab finish from contamination until time of topping. Mechanically remove oil, grease, asphalt, paint, clay stains or other contaminants, leaving clean surface.

2. Prior to placement of topping or fill, thoroughly dampen roughened slab surface and leave free of standing water. Immediately before topping or fill is placed, scrub coat of bonding grout into surface. Do not allow grout to set or dry before topping or fill is placed.

B. Concrete Fill:

1. Where concrete fill intersects a wall surface at an angle steeper than 45 degrees from vertical, provide a 1.5-inch deep keyway in the wall at the point of intersection; size keyway so that no portion of the concrete fill is less than 1.5 inches thick. Form keyway in new walls; create by saw cutting the top and bottom lines and chipping in existing walls.

2. Apply wood float finish to surfaces of concrete fill.

3. Provide concrete fill at locations shown on Drawings.

C. Bonded Concrete Topping in Bottom of Clarifiers and Thickeners:

1. Minimum thickness of concrete topping: 1 inch. Maximum thickness when swept in by clarifier and thickener equipment: 3 inches.

2. Compact topping and fill by rolling or tamping, bring to established grade, and float. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. Coat surface with evaporation retardant as needed between finishing operations to prevent plastic shrinkage cracks.

3. Screed topping to true surface using installed equipment. Protect equipment from damage during sweeping-in process. Perform sweeping-in process under supervision of equipment manufacturer's factory representative. After topping has been screeded, apply wood float finish. During finishing, do not apply water, dry cement or mixture of dry cement and sand to the surface.

4. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Owner’s Representative, fill the tank with sufficient water to cover the entire floor for 14 days.

5. Provide bonded concrete topping in bottom of all clarifiers and thickeners.

3.08 EPOXY PENETRATING SEALER

A. Surfaces to receive epoxy penetrating sealer: Apply wood float finish. Clean surface and apply sealer in compliance with manufacturer's instructions.

B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: Apply minimum 2-inch-high coverage of floor coating on vertical surface.

C. Mask walls, doors, frames and similar surface to prevent floor coating contact.

D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.

E. Provide epoxy-penetrating sealer at locations indicated on Drawings.

3.09 EPOXY FLOOR TOPPING

A. Surfaces to receive epoxy floor topping: Apply wood float finish unless recommended otherwise by epoxy floor topping manufacturer. Clean surface and apply epoxy floor topping in compliance with manufacturer's recommendations and instructions. Thickness of topping: 1/8 inch.

B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: apply 2-inch-high coverage of floor coating on vertical surface.

C. Mask walls, doors, frames and similar surfaces to prevent floor coating contact.

D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.

E. Finished surface shall be free of trowel marks and dimples.

F. Provide epoxy floor topping at locations indicated on Drawings.

3.10 SEALER/DUSTPROOFER

A. Where sealer or sealer/dustproofer is indicated on Drawings, just prior to completion of construction, apply coat of specified clear sealer/dustproofing compound to exposed interior concrete floors in accordance with manufacturer's instructions.

3.11 NONSLIP FINISH

A. Apply float finish as specified. Apply two-thirds of required abrasive aggregate by method that ensures even coverage without segregation and re-float. Apply remainder of abrasive aggregate at right angles to first application, using heavier application of aggregate in areas not sufficiently covered by first application. Re-float after second application of aggregate and complete operations with troweled finish. Perform finishing operations in a manner that will allow the abrasive aggregate to be exposed and not covered with cement paste.

B. Provide non-slip finish at locations indicated on Drawings.

3.12 FIELD QUALITY CONTROL

A. Flatness and levelness of slabs and similar flat surfaces that are indicated on Drawings to receive "F-Number System" finish will be checked by independent testing laboratory employed by Owner in accordance with Section 01410 - Testing Laboratory Services.

B. Tolerances for "F-Number System" finished surfaces:

1. Floor tolerance shall be determined in accordance with ASTM E1155.

2. Floor flatness and levelness tolerances:

a. F_F defines maximum floor curvature allowed over 24 inches. Computed on the basis of successive 12-inch elevation differentials, F_F is commonly referred to as the "flatness F-Number."

$$F_F = \frac{4.57}{\text{Maximum difference in elevation, in decimal inches, between successive 12" elevation differences.}}$$

b. F_L defines relative conformity of floor surface to horizontal plane as measured over 10-foot distance. F_L is commonly referred to as "levelness F-number."

$$F_L = \frac{12.5}{\text{Maximum difference in elevation, in inches, between two points separated by 10 feet.}}$$

3. Achieve specified overall slab tolerance. Minimum local tolerance (1/2 bay, unless otherwise designated by the Owner's Representative): 2/3 of specified tolerance.

4. Tolerance for floated finish: F_F20/F_L17, unless otherwise shown on Drawings.

5. Tolerance for troweled finish: F_F25/F_L20 for slabs on grade, and F_F25/F_L17 for elevated slabs, unless otherwise shown on Drawings.

3.13 CURING

A. Conform to requirements of Section 03370 - Curing Concrete.

END OF SECTION

SECTION 03370

CONCRETE CURING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Curing of structural concrete.

1.02 UNIT PRICES

A. No separate payment will be made for concrete curing under this Section. Include payment in unit price for structural concrete.

1.03 DEFINITIONS

A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

1.04 SUBMITTALS

A. Conform to all provisions and sections of these specifications.

B. Product Data: Submit description of proposed curing method for concrete. When use of membrane-forming compound is proposed, submit manufacturer's technical information including material specifications, installation instructions and recommendations, and evidence that compound is satisfactory for intended application. State locations where curing compound will be used.

C. When membrane-forming compounds are to be used, submit certification by the manufacturer of compliance with specified requirements and compatibility with toppings, coatings, finishes, and adhesives to be applied.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Membrane-forming Curing Compound: Conform to ASTM C309, Type 1D, and following requirements.

1. Minimum solids content: 30 percent.

2. Compound shall not permanently discolor concrete. When used for liquid-containing structures, curing compound shall be white-pigmented.

3. When used in areas that are to be coated, or that will receive topping or floor covering, material shall not reduce bond of coating, topping, or floor covering

to concrete. Curing compound manufacturer's technical information shall state conditions under which compound will not prevent bond.

4. Conform to local, state and federal solvent emission requirements.

B. Clear Curing and Sealing Compound (VOC Compliant): Conform to ASTM C309, Type 1, Class B, and the following requirements: 30 percent solids content minimum; non-yellowing under ultraviolet light after 500-hour test in accordance with ASTM D4587. Sodium silicate compounds are not permitted. Conform to local, state and federal solvent emission requirements.

C. Sheet Material for Curing Concrete: ASTM C171; waterproof paper, polyethylene film or white burlap-polyethylene sheeting.

D. Curing Mats (for use in Curing Method 2): Heavy shag rugs or carpets, or cotton mats quilted at 4 inches on center; 12 ounce per square yard minimum weight when dry.

E. Water for curing: Clean and potable.

PART 3 E X E C U T I O N

3.01 CURING PROCEDURES

A. Comply with ACI 308 and the requirements specified herein. Protect freshly deposited concrete from premature drying and excessively hot or cold temperatures. Maintain minimal moisture loss and relatively constant temperature during time necessary for hydration of cement and proper hardening of concrete.

B. Unformed Surfaces: For concrete surfaces not in contact with forms, use one of following procedures immediately after completion of placement and finishing.

1. Ponding or continuous sprinkling.

2. Absorptive mat or fabric kept continuously wet.

3. Sand or other covering kept continuously wet.

4. Continuous steam bath (not exceeding 150 degrees F at surface of concrete).

5. Vapor mist bath.

6. Membrane-forming curing compound applied according to manufacturer's recommendations. After the curing compound has dried, wet slab surfaces and cover with waterproof paper, polyethylene film, or white burlap-polyethylene sheeting after the application of the curing compound. Tape sheet seams together and provide sufficient weights to keep the sheeting in

place. Wet the slab surface again if the sheeting becomes dislodged, and replace the sheeting.

7. Other moisture-retaining coverings as approved by the Owner's Representative.

C. Restrictions on Use of Curing Compounds: Unless curing compound manufacturer certifies that curing compound will not prevent bond to cured surface, do not use curing compound on surfaces that will be rubbed or receive additional concrete, mortar, topping, terrazzo or other cementitious finishing materials, on slabs under resilient floors or built-up roofing, or on surfaces to be waterproofed, sealed, hardened or painted.

D. Curing and Sealing Compounds: At locations indicated, cure exposed interior slabs and troweled slabs receiving mastic-applied adhesives with specified clear curing and sealing compound in accordance with manufacturer's recommendations. Do not store materials directly on curing membranes. Use plywood to protect curing membrane from damage. Immediately repair membranes damaged by foot traffic or other operations.

E. Duration of Curing: Continue curing until cumulative number of days or fractions of days during which ambient temperature is above 50 degrees F has totaled 7. Continue curing of water-retaining structures for a total of 14 days. When high-early-strength concrete has been used, continue curing for total of 3 days. Prevent rapid drying at end of curing period.

F. Formed Surfaces: During the curing period keep wet steel forms heated by sun and wood forms in contact with concrete. When forms are to be removed during curing period, employ curing materials or methods immediately. Continue such curing for remainder of curing period.

G. Temperature:

1. Cold Weather: When mean daily temperature of atmosphere is less than 40 degrees F, maintain temperature of concrete between 50 and 70 degrees F for required curing period. When necessary, make arrangements for heating, covering, insulating or housing concrete work in advance of placement to maintain required temperature and moisture conditions. Prevent damage or injury due to concentration of heat. When combustion heaters are necessary in enclosed or protected area where concrete slabs are being placed, vent heaters.

2. Hot Weather: In advance of placement make arrangements for shading, fog spraying, sprinkling, ponding or installation of windbreaks or wet covering of light color. Take such protective measures as quickly as concrete hardening and finishing operations will allow.

3. Temperature Changes: Control so rate of change in temperature of concrete is as uniform as possible. Do not permit temperature change to exceed 5 degrees F in any one hour or 50 degrees F in any 24-hour period.

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

3.02 CURING MASS CONCRETE

A. Observe the following additional restrictions when curing mass concrete.

1. Minimum curing period: 2 weeks.

2. When ambient air temperature falls below 32 degrees F, protect surface of concrete against freezing.

3. Do not use steam or other curing methods that will add heat to concrete.

4. Keep forms and exposed concrete continuously wet for at least the first 48 hours after placing, and whenever surrounding air temperature is above 90 degrees F during final curing period.

5. During 2-week curing period, provide necessary controls to prevent ambient air temperature immediately adjacent to concrete from falling more than 30 degrees F in 24 hours.

END OF SECTION

SECTION 03600

STRUCTURAL GROUT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Non-shrink grout used wherever grout is shown in the Documents, unless another type is specifically referenced. Two classes of non-shrink grout (Class I and II) and areas of application are specified.

1.02 UNIT PRICES

A. Include the cost for grout in the lump sum for each structure in which it will be used. No separate payment will be made for grout.

B. Measurement for extra grout (Class I and II) is on cubic foot basis. Payment includes associated work performed in accordance with related sections included in the Contract Documents.

1.03 SUBMITTALS

A. Conform to all provisions and sections of these specifications.

B. Quality Control:

1. The Contractor shall submit manufacturer's literature certifying compliance with the specified properties for Class I and II grouts.

2. The Contractor shall submit manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

C. The Contractor shall submit manufacturer's written warranty as specified.

1.04 QUALITY ASSURANCE

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. The specimens will be made by the Owner’s Representative or its representative.

2. Compression tests and fabrication of specimens for non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Owner’s Representative. A set of three specimens will be

made for testing at 7 days, 28 days, and each additional time period as appropriate.

3. Grout already placed which fails to meet the requirements of these Specifications is subject to removal and replacement no additional cost to the Owner.

4. The cost of laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Owner's Representative obtaining specimens for testing. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The Contractor shall supply materials necessary for fabricating the test specimens.

B. Warranty:

1. Provide 1-year warranty for work provided under this Section.

2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to only the purchase price of products or materials furnished.

3. Manufacturer shall warrant participation with Contractor in replacing or repairing grout found to be defective due to faulty materials, as determined by industry standard test methods.

PART 2 P R O D U C T S

2.01 APPLICATION

A. The following is a listing of typical applications and the corresponding type of grout which is to be used. Unless indicated otherwise, grouts shall be provided as listed below whether or not called for on the Drawings.

Application:	Type of Grout
Structural member base plates	Non-shrink Class II
Storage tanks and other equipment	Non-shrink Class I
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-shrink Class II (Class I where placement time exceeds 15 minutes)
Under precast concrete elements	Non-shrink Class I

Toppings and concrete fill less than 3 inches thick	Concrete Topping per Section 03310 and Section 03345
Toppings and concrete fill greater than 3 inches thick	Concrete Fill per Section 03310 and Section 03345
Any application not listed above, where grout is called for on the Drawing.	Non-shrink Class I, unless noted otherwise

2.02 PREPACKAGED GROUTS

A. Basic Requirements for Cementitious Non-Shrink Grout

1. Provide prepackaged non-shrink grout that is inorganic, flowable, non-gas-liberating, non-metallic, and cement-based, requiring only the addition of water.

2. Deliver grout in original packaging with manufacturer's instructions printed on each container.

3. Select the specific formulation for each class of non-shrink grout specified to conform to that recommended by the manufacturer for the particular application.

4. Compressive strength at 28 days: 7000 psi minimum.

5. Do not use a grout for which the non-shrink property is based on a chemically generated gas or gypsum expansion.

B. Class I Non-Shrink Grout:

1. Supply Class I Grout conforming to these specifications and to CRD-C621 and ASTM C1107 Grade C and B (as modified below) when tested using the amount of water needed to achieve the following properties:

a. Fluid consistency (20 to 30 seconds) per CRD-C611 at initial testing.

b. Fluid consistency (45 seconds) per CRD-C611 at 30 minutes after mixing.

c. At temperatures of 45, 73.4, and 95 degrees F.

2. To satisfy non-shrink requirements, the length change from placement to time of final set shall not have a shrinkage greater than the amount of expansion measured after final set at 3 and 14 days. The expansion at 3 and 14 days shall not exceed the 28-day expansion.

3. Fluid grout shall pass through the flow cone, with a continuous flow, 1 hour after mixing.

4. Demonstrate in tests that grout maintains contact with the base plate to provide a minimum effective bearing area of 95 percent of the gross contact area after final set.

5. The grout packaging shall list weight, maximum amount of mixing water to be used, maximum usable working time (pot life) at flowable consistency, and temperature restrictions for preparation and placement within which grout will meet specified requirements.

C. Class II Non-Shrink Grout:

1. Supply Class II Grout confirming to ASTM C1107 and the following requirements when tested using the amount of water needed to achieve the following properties:

a. Flowable consistency: 140 percent flow on ASTM C230, five drops in 30 seconds.

b. Fluid working time: 15 minutes, minimum.

c. Flowable duration: 30 minutes, minimum.

2. When tested, the grout shall not bleed at maximum allowed water.

2.03 CURING MATERIALS

A. Curing materials: As specified in Section 03370 - Concrete Curing and as recommended by the manufacturer of prepackaged grouts.

2.04 CONSISTENCY

A. Mix grouts to the consistency necessary to completely fill the space to be grouted. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify that base concrete or masonry has attained design strength before grout is placed.

B. When cementitious grouts are used on concrete surfaces, saturate the concrete surface with water for 24 hours prior to placement of cement-based grout. Upon completion of saturation period remove excess water prior to grouting.

3.02 GROUTING PROCEDURES

A. Prepackaged Grouts: Perform mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts according to the written instructions of the manufacturer. Use prepackaged materials in the quantities and proportions as directed by the manufacturer unless there is certified test data verifying that the specified properties are attained by modified mix.

3.03 CONSOLIDATION

A. Place grout in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL FRAMING

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

This section includes the requirements for the provision of structural steel framing.

1.02 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Threaded rods
5. Shop primer
6. Galvanized-steel primer.
7. Etching cleaner
8. Galvanized repair paint

B. Shop Drawings. Checked by fabricator and Contractor before submission.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard QWS symbols, distinguishing between shop and filed welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain,
4. Indicate size, type, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical, high-strength bolts.
5. Identify members not to be shop primed.

C. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 INFORMATION SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.

2. Direct-tension indicators.

3. Tension-control, high-strength, bolt-nut-washer assemblies.

4. Shear stud connectors.

F. Foreign manufactured steel shall be tested for conformance to ASTM requirements by an independent testing laboratory located in the United States and approved by the Owner's Representative. Cost of such test is not part of any testing allowance included in this specification and shall be borne by the fabricator. Certification from any other source is not acceptable.

1.04 QUALITY ASSURANCE

A. Comply with applicable provisions of the following except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges" (modified in paragraph 4.2.1 by deletion of the following sentence: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as a part of his preparation of these shop drawings.").

2. Qualification of Welding Work. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."

3. Connections. Structural steel fabricator shall be responsible for design of all structural steel connections not detailed on the construction documents. The design of all steel connections not shown on the drawings shall be performed under the direct supervision of a Professional Engineer registered in the State of Texas, employed by the fabricator.

1.05 TESTING LABORATORY SERVICES

A. Tests. Architect may order observation and testing of shop welds and bolted work for conformance with specifications. Laboratory may also be ordered to make x-ray tests of completed welds.

B. Nonconforming Work. Replace such work failing to conform to the above test or examination with new materials or repair, if possible, in a manner as approved by the Owner's Representative at no additional cost to the Owner. Costs of retests or reexaminations on this work shall be paid by the Contractor. Costs of testing laboratory services, except as noted herein, will be furnished under Section 01455, Testing Laboratory Services.

1.06 DELIVERY AND STORAGE

A. Schedule material and delivery so that items may be erected promptly after arrival. If materials must be stored at the project site, they shall be stored above ground on platforms, skids or other supports. Material stored at the site shall be kept free of dirt, mud, grease or oil. Protect stored material from corrosion.

PART 2 - P R O D U C T S

2.01 MATERIALS

A. W-Shapes: ASTM A 992, Grade 50 (galvanized) or ASTM A276, Grade 316/316L Stainless Steel, as noted on the drawings.

B. Channels and Angles: ASTM A 36, 50 (galvanized) or ASTM A276, Grade 316/316L Stainless Steel, as noted on the drawings.

C. Plate and Bar: ASTM A 36 (galvanized) or ASTM A276, Grade 316/316L Stainless Steel, as noted on the drawings.

D. Structural Steel Tube. ASTM A 500, Grade B. (galvanized)

E. Welding Electrodes: Comply with AWS requirements. Rolled Steel Plates, Shapes and Bars. ASTM A 36, ASTM A 529, Grade 42/50, or ASTM A 572, Grade 50, as noted on the drawings. (galvanized)

F. Bolts. ASTM F 593, Type 316 or as specified on the drawings. (stainless steel)

G. Anchor Bolts. ASTM A 304. (stainless steel)

H. Shrinkage Resistant Grout (SR-G). Corps of Engineers CRD-621-80, pre-mixed, factory packaged, nonmetallic aggregate mortar grouting compound, such as Euclid "High-Flow" nonshrink grout or Master Builders "Masterflow 713," or approved substitution.

2.02 FABRICATION

A. Connections. Weld or bolt shop connections, bolt field connections except as otherwise noted on the drawings. Design connections not otherwise detailed or noted for half the total uniform load capacity tabulated in the appropriate beam load tables, AISC "Manual of Steel Construction."

B. Holes. Provide holes required for securing other work to structural steel.

C. Base Plates. Column to base plate connection shall be fillet welded all around. Size shall be AWS minimum for the thickness of materials joined (3/16 inch minimum) unless noted otherwise on the drawings.

2.03 WELDING

A. Comply with AWS code of procedures, appearance and quality of welds and methods used in correcting welding work. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

2.04 ZINC (HOT GALVANIZED) COATING

2.05 Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

A. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

B. All structural members or fabricated assemblies, steel fasteners & accessories on this project are to be galvanized.

C. Galvanize lintels, shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

PART 3 - E X E C U T I O N

3.01 INSTALLATION

A. Temporary Shoring and Bracing. Provide temporary shoring and shoring members as required, with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide guy lines to achieve proper alignment of the structure as erection proceeds.

B. Setting Bases and Bearing Plates.

1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates.

2. Set loose and attached base plates and bearing plates for structural members on wedges, or other adjustable devices. Tighten anchor bolts after supported members have been positioned and plumbed.

3. Mix bedding mortar in strict accordance with the manufacturer's instructions. Pack bedding mortar solidly between bearing surfaces and bases or plates to ensure no voids remain. Finish exposed surfaces and allow to cure in strict compliance with manufacturer's instructions.

C. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Adjust to compensate for discrepancies in elevations and alignment. Level and plumb individual members of the structure within specified AISC tolerances.

D. Splice members only where shown or specified.

E. Do not enlarge unfair holes in members by burning or by use of drift pins. Ream holes that must be enlarged to admit bolts.

F. Do not use gas cutting torches in the field for correcting fabrication errors in structural framing.

END OF SECTION

SECTION 05500

MISCELLANEOUS METALS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section includes the requirements for furnishing and installing miscellaneous metal items, including grating, treads, and nosings. Stairs are not included.

B. Review drawings and other sections of the specifications for the extent of miscellaneous metal work required. All metal work not included under other sections of the specifications shall be furnished and installed under this section.

C. Furnish all bolts, anchors, sleeves, and other devices to be built into construction for support of miscellaneous metal items.

D. Pipe Sleeves for mechanical and electrical work are to be provided under Division 15 – Mechanical and Division 16 – Electrical.

1.02 RELATED WORK

A. Testing Laboratory Services. Section 01455.

B. Nonshrink Grouting. Section 03605

C. Division 5 – Metals. Coordinate the requirements of this section with all other sections of Division 5 – Metals.

D. Protective Coating for Wastewater Systems. Section 09928.

1.03 QUALITY ASSURANCE

A. Comply with the provisions of the following codes, standards and specifications, except as otherwise shown or specified:

B. AISC, "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings," including the "Commentary" on the AISC Specification.

C. AISI, "Specification for the Design of Cold-Formed Steel Structural Members."

D. AWS, "Code for Welding in Building Construction."

E. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."

F. Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and registered in the State of Texas.

G. Coordinate dimensions shown on drawings with field measurements before fabrication.

1.04 SUBMITTALS

A. Submit shop drawings for fabrication and erection of miscellaneous metal items checked by both fabricator and Contractor before submission. Submit manufacturer's data and installation instructions for prefabricated items. Indicate profiles, sizes, connections, reinforcing, anchorage, size and type of fasteners and accessories.

B. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Structural Steel W-Shapes. ASTM A992, Grade 50. (galvanized)

B. Structural Steel Plates, Channels, and Angles. ASTM A 36 or ASTM A992, Grade 50. (galvanized)

C. Stainless Steel Bars and Shapes. ASTM A276, Grade 316L.

D. Structural Pipe. ASTM B 429, 6063-T6 or 6061-T6 aluminum alloy. (aluminum)

E. Structural Tube. ASTM A1016, Grade 316/316L. (stainless steel)

F. Zinc Coating (Hot-Dip) on Iron and Steel Hardware. ASTM A 153.

G. Bolts. ASTM F 593, Type 316, regular hex head. (stainless steel)

H. Nuts. ASTM F 594, Type 316. (stainless steel)

I. Washers: Comply with ASTM for requirements for bolts used.

J. Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes. ASTM A 500, Grade B.

K. Zinc (Hot Galvanized) Coating. Members or fabricated assemblies designated to be galvanized shall comply with ASTM A 123 for products fabricated from

rolled, pressed and forged steel shapes, plates, bars and strips. Galvanize after fabrication.

L. Extruded Aluminum Shapes. Conform to ASTM B221, Alloy 6061-T6.

M. Galvanized Sheet Steel. Conform to ASTM A653, commercial quality hot-dipped zinc-coated sheets fabricated of commercial quality cold-rolled steel, containing designation G90, mill phosphatized, not oiled.

N. Stainless Steel Sheet, Strip, and Plate. Conform to ASTM A240, Type 316.

O. Stainless Steel Wire Rope. Wire rope manufactured from stainless steel wire complying with ASTM A492, Type 316.

1. Wire Rope Fittings: Stainless steel connectors, Type 316, with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

P. Anchor bolts

1. Stainless steel anchor bolts shall be Type 316 conforming to ASTM F 593. Use stainless steel anchor bolts where shown on the drawings as "stainless steel," "stn. steel" or "SS." Provide stainless steel anchor bolts with suitable stainless steel nuts and oversize washers.

2. Provide anchor bolts for all equipment and machinery when anchor bolts are not furnished by the manufacturer. Anchor bolt type, size, length, projection, etc., shall conform to the requirements of the equipment and machinery manufacturer.

3. Provide templets to accurately position the anchor bolts in the forms

Q. Aluminum Stair Treads. Stair treads shall be aluminum grating treads with 1-inch by 3/16-inch bearing bars on 1-3/16-inch centers and crossbars on 4-inch centers. Wearing surface of bearing bars and crossbars shall be plain. The stair tread shall have a abrasive nosing for its full length. The length and width of the treads shall be as shown on the drawings. The stair treads shall be bolted to the stair stringers.

R. Ladder Rungs. Ladder rungs shall be abrasive-surfaced nonskid galvanized steel rungs. Ladder rungs shall be welded to the stringers.

S. Abrasive Cast Aluminum Nosings. Nosings for concrete stairs shall be cast aluminum not less than 3 inches from front to back, not less than 5/16 inch thick and 6 inches shorter than the tread width. The top of the nosing shall have a hatched abrasive surface. The nosing shall have anchors on the underside. Place one anchor at each end and stagger intermediate anchors approximately 13 inches

apart. No finish is required. Provide abrasive cast aluminum nosings for all concrete stairs and landings.

T. Grout. Conform to the requirements of Section 03605, Grouting.

U. Paint for Shop Primer.

1. For all submerged steel, use a primer suitable for use with a coal-tar epoxy paint system as specified in Section 09928 – Protective Coatings for Wastewater Systems.

2. For all other steel, use a primer suitable for use with the epoxy-polyurethane paint system as specified in Section 09928 – Protective Coatings for Wastewater Systems.

V. Galvanizing Repair Coating. Hot-applied zinc-based solder conforming to the requirements of ASTM A 780.

W. Miscellaneous Framing and Supports.

1. Provide miscellaneous steel framing and supports which are not a part of the structural system and not shown on structural drawings.

2. Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not shown, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from steel units to receive hardware and similar items.

3. Provide bolts, screws and other fastenings as required to connect steel to other materials.

X. Bollards. Provide galvanized steel pipe as sized on drawings, concrete filled with crowned cap. Provide field painted finish.

2.02 FABRICATION

A. Verify all dimensions and take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Miscellaneous bolts and anchors, supports, braces and connections necessary for completion of the miscellaneous metal work shall be provided so that work can be assembled in a neat and substantial manner.

B. Use materials of the size and thicknesses shown or, if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use. Use type of materials shown or specified for the various components of the work.

C. Assembly. Where practical fit and assemble items in the shop and deliver to the site ready for installation.

D. Form exposed work true to line and level with accurate angles and surfaces and sharp straight edges. Ease exposed edges to a radius of approximately 1/32 inch. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

E. Weld corners and seams continuously and in accordance with the AWS code. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

F. Form exposed connections with hairline joints which are tight, flush and smooth using concealed fasteners wherever possible.

1. Mechanical Fastenings Exposed to View. Provide flush countersunk screws or bolts; unobtrusively located; consistent with design of component.

2. Mechanical Fastenings Concealed by Other Work. Provide hex head bolted connection.

G. Provide for anchorage of the type shown, coordinated with the supporting structure. Fabricate and space anchoring devices as shown and as required to provide adequate support of the work.

H. Cut, reinforce, drill and tap miscellaneous metal work as may be required to receive other items of work. Poor matching of holes will be cause for rejection.

I. Hot-dip galvanize to coating thickness of 1.25 ounces per square foot all items shown on the drawings to be galvanized.

2.03 PROTECTIVE COATING FOR ALUMINUM GRATING SUPPORTS

The top of steel support beams and seats for aluminum grating shall be coated with a heavy coat of alkali-resistant bituminous paint or similar coating to prevent contact between the steel and the aluminum grating.

2.04 ALUMINUM FINISHES

Clear Anodic Finish: 0.7-mil-thick AAMA 611, Class 1.

PART 3 E X E C U T I O N

3.01 CONDITION OF SURFACES

A. Prior to installation, inspect surfaces to which miscellaneous metal items will be attached. If the condition of the surface is such that it will adversely affect installation, do not proceed with installation until corrective measures have been taken.

B. Verify that aluminum surfaces that will be in contact with concrete or steel have been coated as specified.

3.02 INSTALLATION

A. Accurately set work to established lines and elevations and securely fasten in accordance with approved shop drawings and provisions of this section.

B. The Contractor shall be fully responsible for furnishing and installing any temporary braces, ties or shoring necessary to hold secure and safe all items under the action of wind and erection loads imposed thereon until construction is completed.

3.03 WELDING

A. Welding Steel. Conform to requirements of AWS D1.1, Structural Welding Code - Steel.

B. Welding Aluminum. Conform to requirements of AWS D1.2, Structural Welding Code - Aluminum.

C. Welding Stainless Steel. Conform to requirements of AWS D1.3, Structural Welding Code – Stainless Steel.

3.04 GROUTING

A. Grout for base plates, etc., shall be as specified in Section 03605, Nonshrink Grout.

3.05 COATING REPAIRS

A. Thoroughly clean field welds, abrasions, and damaged or defective areas of shop-primed or galvanized surfaces.

B. Painted Surfaces. Prepare the surface as previously specified for shop painting. After the surface is prepared, apply a heavy coat of matching shop paint.

C. Galvanized Surfaces. Prepare the damaged surface and apply a minimum of 2 mils of the specified galvanized repair coating in conformance with the requirements of ASTM A 780. Where the repair coating manufacturer's recommendations are more stringent than ASTM A 780, the manufacturer's recommendations shall be followed.

3.06 MISCELLANEOUS METAL ITEMS

A. Miscellaneous metal items listed herein are typical for this section. Refer to the drawings for additional items not listed herein. All structural steel used on this project shall be hot-dip galvanized. All fasteners and washers shall be galvanized or stainless steel.

3.07 FINISHES

A. Do not weld, cut or abrade the surfaces of units which have been hot-dip galvanized after fabrication and are intended for bolted, fitted connections. Cleaning and touch-up of galvanized finish at field welds, bolted connections and abraded areas is specified in Section 05120, Structural Steel Framing.

END OF SECTION

SECTION 05510

PREMANUFACTURED METAL STAIRS AND WALKWAYS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

This section includes the requirements for the provision of prefabricated metal stairs and walkways. All metal stairs and walkways for this project shall be premanufactured.

1.02 RELATED WORK

A. Miscellaneous Metals. Section 05500.

B. Aluminum Handrail and Railing. Section 05521.

1.03 DESIGN REQUIREMENTS

A. Stairs and walkways shall comply with SBC, OSHA, and NFPA 101 Life Safety code.

B. Stairs and walkways shall conform to "Industrial Occupancy" Unaccessible to the public, unless otherwise indicated on the Drawings.

C. Stair and walkway systems shall be designed and fabricated to support the following loads:

1. Dead load consisting of the self-weight of all materials.

2. Live load of 100 psf and a concentrated load of 300 lb at any location, not concurrent.

3. Wind load per ASCE 7-10 as show on the Structural General Notes sheet.

D. Flood Loads shall be neglected. (See section 1.03.E. Stairs are intended to be sacrificial in the event of a flood event.)

E. Stair and walkway systems shall be designed and fabricated to limit the deflections and drift as follows:

1. Stringer Deflection: not to exceed L/240 or 1/4 inch, whichever is less.

2. Tread and Grating Deflection: not to exceed L/240 or 1/4 inch, whichever is less.

3. Column Drift: not to exceed H/240 or 3/4 inch, whichever is less.

F. Minimum tread width: 12” with 1” overlap at toe

G. Minimum grating depth: 1 1/2" or as needed to meet deflection requirements.

H. Slope of stair: per OSHA requirements.

I. Stairs are intended to be sacrificial in the event of a flood event. Stair system must be free standing with a 1” gap between the stair and top of platform/structure. Stairs are not to be anchored directly to the platform/structures.

J. Miscellaneous Foundations shall be designed for an allowable bearing pressure of 2000 psf.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer’s product data and installation instructions.

B. Submit certification, signed by a Professional Engineer registered in Texas, that the design complies with the requirements of this specification and is in accordance with accepted engineering practices.

C. Shop drawings. Clearly show the following:

1. Stair plans, elevations, details, methods of installation, and anchoring.

2. Member sizes and thickness, anchorage location and anchorage items.

3. Furnish setting diagrams for anchorage installation as required.

4. Include calculations signed and sealed by a structural engineer licensed in the State of Texas indicating design loads and deflections.

1.05 QUALITY ASSURANCE

A. Comply with the provisions of the following codes, standards and specifications, except as otherwise shown or specified.

1. AISC, “Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings,” including the “Commentary” on the AISC Specifications.

2. AISI, “Specification for the Design of Cold-Formed Steel Structural Members.”

3. AWS, "Code for Welding in Building Construction."

B. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."

C. Comply with applicable safety requirements of OSHA and applicable local building codes plus the Texas Accessibility Standards (TAS), Article 9102 of Vernon's Texas Civil Statutes.

PART 2 P R O D U C T S

2.01 MANUFACTURER

A. Premanufactured stairs such as those by Anderson Industries, Sharon, etc. shall be used, subject to the requirements of this section.

2.02 MATERIALS

A. Aluminum

1. Aluminum bars, plates, rods, and shapes for aluminum stairs and walkways shall be ASTM B221, Alloy 6061-T6 unless otherwise shown or specified.

2. Aluminum Pipe shall be ASTM B 429, 6063-T6 or 6061-T6 aluminum alloy.

3. Stair treads shall be aluminum grating treads with 1-inch by 3/16-inch bearing bars on 1-3/16-inch centers and crossbars on 4-inch centers. Wearing surface of bearing bars and crossbars shall be plain. The stair tread shall have an abrasive nosing for its full length. The length and width of the treads shall be as shown on the drawings. The stair treads shall be bolted to the stair stringers.

4. Aluminum Handrail and Guardrail shall comply with Specification Section 05521 – Aluminum Handrail and Railing

B. <u>Welding Electrodes</u>

1. Use 4043 filler metal for aluminum.

2. Use type E308 electrode where the base metal is type 304 stainless steel and type E309 where the base metal is type 316 stainless steel or where stainless steel is welded to carbon steel.

C. Anchor Bolts and Fasteners

1. Fasteners shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M.

2. Concrete Anchors shall be Type 316 stainless steel conforming to ASTM F 593. Provide stainless steel anchors with suitable stainless steel nuts and oversize washers.

D. FRP Grating

1. Comply with Specification Section 06632 – Glass Fiber Reinforced Plastic Grating.

2.03 FABRICATION

A. General

1. Use materials of the required size and thickness to produce adequate strength and durability in the finished product for the intended use. Work to the dimensions shown or in accordance with job measurements. Use type of materials shown or specified for the various components of the work.

2. Form exposed work true to line and level, with accurate angles and surfaces and sharp straight edges. Ease exposed edges to a radius of approximately 1/32 inch. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

3. Weld corners and seams continuously and in accordance with the AWS code. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

4. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible.

5. Provide for anchorage coordinated with the supporting structure. Fabricate and space anchoring devices as required to provide adequate support of the work.

6. Cut, reinforce, drill and tap miscellaneous metal work as may be required to receive other items of work.

7. Fabricate aluminum stairway frame of aluminum structural shapes. Frame for each run of aluminum stairway shall be continuous, without joints.

8. Provide aluminum stairways with aluminum treads and aluminum handrail and guard railing.

B. Aluminum Connections

1. Connections between aluminum members shall be aluminum bars, plates, and shapes or fabricated of AISI 304 or AISI 3 16 stainless steel.

2. Connections between aluminum sections and aluminum fabrications, such as landings, walkways, and platforms, shall be aluminum bars, plates, and shapes or fabricated of AISI 304 or AISI 316 stainless steel.

3. Connections between aluminum and concrete shall be fabricated of AISI 3 16 stainless steel.

4. Connections between aluminum and steel fabrications, such as landings, walkways, and platforms, shall be fabricated of AISI 3 16 stainless steel.

C. Aluminum Stair Treads

1. Aluminum stair treads shall be same pattern and alloys as aluminum walkway grating.

2. Aluminum stair treads shall be a minimum of 1-1/2 inches thick, unless otherwise indicated on the drawings.

3. Aluminum stair treads shall have 1-1/4-inch wide abrasive nosing.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Take field measurements prior to preparation of shop drawings.

B. Install stair components in accordance with manufacturer's recommendations, approved submittals, and in proper relationship with adjacent construction.

C. Erect stair work to line, plumb, square and true with runs registering level with finished floor and platform levels.

D. Perform all cutting, drilling and installation of stair systems. Fit exposed connections together to form tight hairline joints. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop finish.

E. Do not weld, cut or abrade the surfaces of units which have been anodized after fabrication and are intended for bolted, fitted connections.

3.02 PREVENTION OF ELECTROLYSIS

A. Aluminum in contact with dissimilar metals shall be separated with 1/8" thick layer of neoprene backing pad of full abutting area.

B. Install corrosion barriers between aluminum and concrete.

1. Coat bottom of surface mounted aluminum railing posts and aluminum clip angles as specified in Section 09928 Protective Coating for Embedments.

2. Install vinyl or neoprene barrier pad between bottom of surface mounted aluminum railing post, or angle clip, and concrete.' Area of pad shall equal area of aluminum surface.

C. Coat aluminum embedded in concrete or grout as specified in Section 09928 Protective Coating for Embedments.

END OF SECTION

SECTION 05521

ALUMINUM HANDRAIL AND RAILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes the requirements for the provision of aluminum handrail and railing.

1.02 DESIGN CRITERIA

A. Spacing of vertical post shall not exceed 4 feet center to center. Provide the number of intermediate rails as shown on the drawings.

B. Adequate provisions shall be made for the thermal expansion and contraction of the railing. Provide expansion joints at intervals of not more than 40 feet on center and where the railing crosses expansion joints in the structure.

C. Railing shall be designed in accordance with the Aluminum Association's "Specifications for Aluminum Structures, Construction Manual Series 1."

D. The handrail and railing shall meet or exceed all applicable OSHA requirements, local building code requirements and the requirements of this specification. The most stringent requirements shall control.

E. The railing and handrail shall withstand a force of 200 pounds applied at any location in any direction without permanent deformation. The anchorage shall have a minimum load capacity of 400 pounds at failure. For railing posts, the load shall be applied at the top rail. Test results from an independent testing laboratory will be required.

1.03 SUBMITTALS

A. Shop Drawings. Show handrail and railing layout, mark numbers, connection and anchorage details, expansion joint details, material type, thickness and finish, and the dimensions and shape of each component. Indicate method for protection of aluminum at contact points with concrete or steel. Shop drawings shall also include details of safety gates. Reproduction of design drawings for use as shop drawings will not be allowed.

B. Manufacturer's Product Data. Submit manufacturer's technical information on the handrail and railing system proposed for use by the Contractor. The data shall contain sufficient information to evaluate conformance to the specifications and suitability for the intended use.

C. Test Data. Submit test data from a certified independent laboratory showing that the handrail and railing system meets OSHA's standard load requirements and any additional load and deflection requirements as specified herein.

D. Sample. Furnish full-size sample of handrail including typical intermediate post, corner post and accessories.

1.04 FIELD MEASUREMENTS

Prior to fabrication, take necessary field measurements of previously installed construction so that work will fit properly. Members that do not fit properly must be replaced unless written approval for their modification has been obtained from the Engineer.

1.05 PRODUCT DELIVERY AND STORAGE

A. Each handrail and railing section shall be tagged with a weatherproof tag showing section mark number corresponding with reviewed shop drawings.

B. Protect handrail and railing during shipping and storage to prevent finish scratches, nicks, gouges or dents. Material damaged in a manner that will affect durability, strength or appearance and which cannot be repaired to the satisfaction of the Engineer shall be replaced without additional cost to the Owner.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Rails. 1-1/4-inch-round nominal diameter, Schedule 40 pipe extruded from 5086 aluminum alloy conforming to ASTM B 221. The outside diameter of the pipe shall be 1.66 inches.

B. Posts. 2-inch round nominal diameter pipe conforming to the same requirements as the rails; or, as an alternate, the posts may be fabricated from extruded rectangular tubes of the same material as specified for the rails.

C. Fittings. 5086 aluminum alloy. Tee-fittings and elbows which are fabricated from more than one piece shall be of welded construction with no weld marks visible when fittings are installed.

D. Mechanical Fasteners. Type 316 stainless steel.

E. Bolts. Bolts for bolted connections to steel support members shall be AISI Type 316 stainless steel conforming to ASTM A 193.

F. Anchor Bolts. Stainless steel expansion anchors.

G. Mounting Plates and Brackets. Railing system manufacturer's standard aluminum plates and brackets. Railing mounted on top of concrete shall have a four-bolt connection as detailed on the drawings.

H. Toeboards. Where indicated on the drawings, provide 1/4-inch-thick by 4-inch-wide extruded aluminum toeboards with stiffener rib as detailed on the drawings. As an alternate, toeboards may be 4-inch aluminum channels. Securely fasten toeboard in place with no more than 1/4-inch clearance above floor level.

I. Safety Gates. Construct of the same size pipe as the railing. The gate shall have a minimum gate swing of 90 degrees. Gates shall be equipped with a self-closing latch and gate stop. The gate and latch shall be capable of resisting a 200-pound load as required by OSHA.

J. Nonshrink Grout. Conform to the requirements of Section 03605, Grouting.

2.02 FINISHES

A. Exposed aluminum surfaces shall have a 0.7-mil-thick clear anodized Architectural Class I coating conforming to the Aluminum Association designation M43C22A41.

B. Aluminum surfaces that will be in contact with concrete or steel shall be given a heavy coat of alkali-resistant bituminous paint, or other coating recommended by the manufacturer that will provide equivalent protection. The coating shall not be visible in the completed installation.

C. The Owner reserves the right to have production samples of finishes tested for compliance with minimum requirements by the following methods:

1. Coating weight - ASTM B 137.
2. Coating thickness - ASTM B 244.
3. Sealing - ASTM B 136.
4. Coating resistance to abrasion - ASTM D 658.

2.03 FABRICATION

A. Perform work in accordance with approved shop drawings as modified for actual field measurements.

B. Posts shall be single unspliced lengths of pipe. Where possible, an unspliced length of top rail shall be attached to a minimum of three posts.

C. Provide toeboards at locations where required as shown on the drawings.

D. Joints at tees and crosses shall be formed with flush fittings; or, when fittings are not used, the end of the pipe shall be notched to fit the contour of the pipe to which it is joined.

E. All miters, joints, splices and saw cuts must be accurately joined. Cuts must be straight and free of any burrs or nicks. Miter cuts must be smoothed after joining. All joints and connections must be tight and flush.

F. Provide internal line-up members at joints and splices. Countersink fasteners to provide a continuous smooth flush surface. Expansion joints and splices shall be located within 12 inches of a post. As an alternate, the internal line-up members may be attached with epoxy adhesive. Fasten only one end at expansion joints. Fasten both ends at splice joints.

G. All holes for field fastening shall be factory predrilled.

H. Form elbow bends and wall returns to uniform radius, free from buckles and twists with smooth finish surfaces. Flush fittings with full welded connections may be used for elbow bends and wall returns. Welds shall be ground smooth.

I. Close ends of pipe with 3/16-inch welded plate or prefabricated fittings.

J. All welding shall be done in the shop. Weld marks must not be visible in the completed installation. Field welding will not be permitted. Welding shall conform to AWS D1.2.

K. Form and assemble joints which will be exposed to weather so as to exclude water.

L. For exterior installations provide drain holes as recommended by the railing manufacturer.

M. When posts are set in concrete, furnish 6-inch-long aluminum sleeves with closure plate tack welded to the bottom of the sleeve. The inside diameter of the sleeves shall be a minimum of 2-1/2-inch diameter to leave room for nonshrink grout.

N. All work shall be free from blemishes or defects of any type which can affect durability, strength or appearance.

PART 3 E X E C U T I O N

3.01 ERECTION TOLERANCES

A. Set posts plumb and aligned to within 1/8 inch.

B. Set rails horizontal to within 1/8 inch in 12 feet. On stairs, set rails parallel to rake of steps within 1/8 inch in 12 feet.

3.02 ERECTION

Prior to erection, verify that aluminum surfaces that will be in contact with concrete or steel have received the protective coating specified in 2.2B.

A. Embedded Railing Posts. If sleeves for anchoring of posts were not cast into the concrete, drill holes into the concrete with a minimum diameter of 1 inch larger than the outside diameter of the post and a minimum of 6 inches deep. Clean all dust and foreign matter from the sleeve or drilled hole. After setting and plumbing the post, fill the annular space around the post with nonshrink grout. Slope grout away from post.

B. Base Plate Mounted Railing Post on Concrete. Anchor base plates to concrete with stainless steel expansion anchors. Anchor size, spacing and minimum embedment of expansion anchors shall be as detailed. Install expansion anchors in accordance with manufacturer's instructions. Provide aluminum shims under base plate as required for alignment.

C. Bracket-Mounted Railing Post to Side of Concrete. Support side-mounted railing with aluminum brackets. Secure brackets to wall with stainless steel expansion anchors. Fasten railing to bracket with stainless steel machine screws.

D. Railing Mounted on Steel. Bolt railing posts to steel support members as detailed with stainless steel bolts. Provide aluminum shims as required for alignment.

E. Removable Railing. Install removable railing as detailed at locations shown on the drawings. Removable railing shall not wobble in its supports.

3.03 PROTECTION AND CLEANING

A. After erection, protect the handrail and railing from damage prior to final acceptance of the project. All handrails and railing shall be free from scratches, nicks, gouges, dents, concrete splatter, paint splatter or other foreign material. Material damaged in a manner that will affect durability, strength or appearance and which cannot be replaced to the satisfaction of the Engineer shall be replaced without additional cost to the Owner.

B. Prior to final acceptance, the handrail and railing shall be cleaned as recommended by the manufacturer.

END OF SECTION

SECTION 05720

ORNAMENTAL HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aluminum decorative railings.

B. Related Requirements:

1. Section 05521 "Aluminum Handrail and Railings" for nonornamental railings fabricated from pipes and tubes.

1.3 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of decorative metal railings assembled from standard components.
2. Perforated metal infill panels.
3. Fasteners.
4. Post-installed anchors.
5. Handrail brackets.
6. Bituminous paint.
7. Nonshrink, nonmetallic grout.
8. Metal finishes.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters
2. Illuminated railing.
3. Fittings, end caps, and brackets.
4. Welded connections.
5. Brazed connections.
6. Cable and cable hardware and connections.
7. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and guard infill. Sample need not be full height.

    a. Show method of connecting and finishing members at intersections.

E. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated-design professional engineer and testing agency.

B. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

F. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

G. Preconstruction test reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups as shown on Drawings.
2. Build mockups for each form and finish of railing, consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 ALUMINUM DECORATIVE RAILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFCO Industries, Inc.
2. Ametco Manufacturing Corporation.
3. C.R. Laurence Co., Inc.
4. Digger Specialties, Inc.
5. Hollaender Mfg. Co.
6. R & B Wagner, Inc.
7. Superior Aluminum Products, Inc.
8. Ultralox Interlocking Technology.
9. VIVA Railings, LLC.

B. Source Limitations: Obtain aluminum decorative railing components from single source from single manufacturer.

C. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

D. Extruded Bars and Shapes, Including Extruded Tubing: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

E. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

F. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.

G. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

H. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.

I. Castings: ASTM B26/B26M, Alloy A356.0-T6.

J. Perforated Metal Infill Panels: Aluminum sheet, ASTM B209 (ASTM B209M), Alloy 6061-T6 of gage necessary to withstand loads indicated, minimum 0.125 inch (3.175 mm) thick, with 1/4-inch (6.4-mm) holes 1/2-inch (12.7-mm) o.c. in staggered rows.

1. Basis-of-Design Product: Provide product with perforations matching Polaris infill panel standard 23% open area by Ametco Manufacturing Corporation.

2.4 FASTENERS

A. Fastener Materials:

1. Aluminum Railing Components: Type 304 stainless steel fasteners.
2. Dissimilar Metal Railing Components: Type 304 stainless steel fasteners.
3. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are the standard fastening method for railings indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast-aluminum, center of handrail 2-1/4 inches (57.15 mm) from inside face of railing.

1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
3. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.
4. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.

B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water.

1. Provide weep holes where water may accumulate.
2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with mechanical connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.

1. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
2. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

K. Form changes in direction as follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.
3. By flush bends or by inserting prefabricated flush-elbow fittings.
4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
5. By bending to smallest radius that will not result in distortion of railing member.

L. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

Q. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

R. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.

1. Provide socket covers designed and fabricated to resist being dislodged.
2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

S. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from aluminum.

1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch (1.1 mm) thick.
2. Orient perforated metal with pattern parallel to top rail.

T. Toe Boards: Where indicated on Drawings, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of

approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 ALUMINUM FINISHES

A. Mechanical Finish: AA-M3x; sand top rails, handrails, and intermediate rails in one direction only, parallel to length of railing, with 120- and 320-grit abrasive. After installation, polish railings with No. 0 steel wool immersed in paste wax, then rub to a luster with a soft dry cloth.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.9 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces.
3. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.

D. Stainless Steel Sheet and Plate Finishes:

1. Directional Satin Finish: ASTM A480/A480M, No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3 m).

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, attached to post with setscrews.

D. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.

E. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum railings, attach posts as indicated, using fittings designed and engineered for this purpose.
2. For copper-alloy railings, attach posts as indicated, using fittings designed and engineered for this purpose.
3. For stainless steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
4. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with sleeves concealed within brackets on underside of rails connected to railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends, using nonwelded connections.

C. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
6. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

2. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09960 "High-Performance Coatings."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings in accordance with ASTM E894 and ASTM E935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.8 CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Clean copper alloys in accordance with metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

C. Clean plastic handrail caps by wiping with a damp cloth and then wiping dry.

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.9 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 - G E N E R A L

1.1 SUBMITTALS

A. Certificates.
1. Submit certificate for waterborne preservative that moisture content was reduced to 19 percent.
2. Submit certificate by treating plant that fire-retardant treatment materials comply with governing ordinances, ASTM E 84, and that treatment will not bleed through finished surfaces.

1.2 DELIVERY, STORAGE AND HANDLING

A. Delivery. Deliver materials in such quantity and in a timely manner so as to ensure the orderly progress of the work.

B. Storage. Store materials above ground surface and sorted as to grades and products.

C. Handling. Use care in off-loading to prevent splitting, breakage or other damage to materials. Remove damaged material or material showing mildew, fungus, or defects making it unsuitable for its intended purpose.

PART 2 - P R O D U C T S

2.1 GENERAL

A. Only new materials shall be used for the work of this section. Use of salvaged material, regardless of condition, is not permitted.

B. Wood materials 2 inches and less in thickness shall be air or kiln dried to a maximum moisture content of 19 percent.

2.2 LUMBER

A. Grading. Grading rules and wood species shall be in conformance with the U.S. Department of Commerce Product Standard PS 20 for American softwood lumber. Grading rules of the Southern Pine Inspection Bureau (SPIB) and West Coast Lumber Inspection Bureau (WCLIB) apply to materials furnished under this section. Identify all lumber by official grade mark containing symbol of grading agency, mill number or name, grade of lumber.

B. Dimensions. Specified and noted dimensions are nominal. Actual dimensions conform to industry standards established by the American Lumber Standards Committee. Lumber shall be surfaced four sides and dressed.

C. Boards and Dimension Lumber. Grade: Southern Yellow Pine (SPIB) No. 2 grade lumber or Construction Grade (WCLIB) Douglas Fir or Hemlock.

2.3 PLYWOOD

A. Grading. Grading rules shall be in conformance with U.S. Department of Commerce Product Standard PS1 for Construction and Industrial Plywood. Identify with appropriate grade mark of the American Plywood Association (APA) indicating type, grade, class and identification index, and showing inspection and testing agency mark.

B. Telephone Backboards. 3/4-inch A-D grade INT-APA.

C. Subfloor. UNDERLAYMENT INT-APA with exterior glue.

D. Sheathing. C-D grade INT-APA with exterior glue.

2.4 ROUGH HARDWARE

A. Bolts, Nuts and Washers. ASTM A 307, Grade A, and USAS B18.2. All bolts embedded in concrete shall be galvanized.

B. Toggle Bolts. FS FF-B-588.

C. Wood Screws. FS FF-S-111.

D. Nails. FS FF-N-105.

2.5 PRESERVATIVE-TREATED WOOD PRODUCTS

A. Treatment. Preservative treated lumber and plywood shall be pressure treated according to Standard C1 of the American Wood Preservers Institute (AWPI).

B. Waterborne Salt Preservatives. AWPI LP-2. Re-dry to moisture content of 19 percent and stamp “dry.” Use “ACQ Preserve” at Contractor’s option.

C. Items. Treat items indicated “treated” on drawings and the following: wood nailers, blocking, stripping, curbs and similar members in connection with roofing and sheet metal, and all other exterior wood, whether exposed or concealed.

2.6 FIRE-RETARDANT TREATMENT

A. Fire Retardant Treatment.
1. Flame Spread Rating. Maximum 25 in accordance with ASTM test E 84.
2. Fire Hazard Classification. UL for treated lumber and plywood.
3. AWPI Standard C20 for lumber, Type B typical, Type A where possible exposure to water exists, e.g., bases in showers, etc.
4. AWPI Standard C27 for plywood.

B. Application. Treat items indicated “FRTW” on drawings and all concealed interior wood members according to AWPI C20 for lumber and AWPI C27 for plywood.

PART 3 - E X E C U T I O N

3.1 GENERAL

A. Application of Material. Use only sound, thoroughly seasoned materials of the longest practical lengths and sizes to minimize jointing. Use materials free from warp that cannot be easily corrected by anchoring and attachment. Sort out and discard warped material and material with other defects that would lower the strength or appearance of the work.

B. Compliance. Materials not complying with the requirements of this section shall not be brought onto or stored at the job site.

C. Workmanship. Produce joints which are tight, true and well joined, with members assembled in accordance with the drawings and with applicable regulations and standards.

3.2 ATTACHMENT

A. Securely attach carpentry work to substrates by anchoring and fastening as shown and as required by recognized standards.

B. Nailing. Use only common wire nails or spikes of dimension sufficient to provide penetration into the piece receiving the point of not less than 1/2 the length of the nail or spike, provided, however, that 16d nails may be used to connect two pieces of 2-inch (nominal) thickness. Nail without splitting wood. Remove split members and replace with members complying with the specified requirements.

C. Bolting. Drill holes 1/16 inch larger in diameter than the bolts being used. Drill straight and true from one side only. Do not bear bolt heads on wood but use washers under head and nut where both bear on wood and use washers under all nuts.

D. Screws. For lag screws and wood screws, holes may be pre-bored to same diameter as root of threads, enlarging holes to shank diameter for length of shank.

3.3 ALIGNMENT

A. Set carpentry work accurately to required levels and lines with members straight, plumb and true and accurately cut and fitted. Members to receive finished surfaces shall not vary more than 1/8 inch from the plane of adjacent furring and framing materials.

3.4 WOOD GROUNDS, NAILERS, BLOCKING AND SLEEPERS

A. Location. Provide wherever shown and where required for the attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

B. Attachment. Attach to substrates securely with bolts or other attachment devices as shown or as required to support applied loading. Countersink bolts and nuts flush with exposed surfaces unless otherwise shown.

3.5 WOOD FURRING

A. Install plumb and level with closure strips at all edges and openings. Shim with wood as required.

3.6 PLATFORM FRAMING

A. Erect framing members plumb and level, adequately secured with bolts, nails, or other fastenings required.

B. Frame platform with wood joists, crowns up, securely nailed to plates or sills.

C. Install plywood sheathing with face grain perpendicular to supports. Provide edge support with lumber blocking between joists. Nail at 6 inches o.c. along panel edges and 12 inches o.c. at intermediate supports, using 8d common nails. Space panel ends 1/16 inch and edges 1/8 inch apart. Protect plywood from moisture by use of waterproof covering until plywood is covered with next permanent component of finish material.

D. Cut stair stringers accurately to lines of treads and risers, securing stringers to platform framing and framing anchors.

END OF SECTION

SECTION 06105

MISCELLANEOUS CARPENTRY

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rooftop equipment bases and support curbs.

2. Wood blocking, cants and nailers.

1.3 DEFINITIONS

A. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.

2. NHLA: National Hardwood Lumber Association.

3. NLGA: National Lumber Grades Authority.

4. SPIB: The Southern Pine Inspection Bureau.

5. WCLIB: West Coast Lumber Inspection Bureau.

6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - P R O D U C T S

2.1 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b for exterior construction not in contact with the ground. See Evaluations in Section 06100 "Rough Carpentry" for information about treatment chemicals.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Application: Treat all miscellaneous carpentry unless otherwise indicated:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.2 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.

2. Nailers.

3. Rooftop equipment bases and support curbs.

4. Cants.

B. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153Mof Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: ASTM C 954, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2

2.4 METAL FRAMING ANCHORS

A. Stainless-Steel Sheet: ASTM A 666, Type 316.

1. Use for exterior locations and where indicated.

PART 3 - E X E C U T I O N

3.1 INSTALLATION, GENERAL

A. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

B. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use copper naphthenate for items not continuously protected from liquid water.

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SECTION 06632

FIBERGLASS REINFORCED PLASTIC (FRP) GRATING

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. This section includes the requirements for the provision of materials, fabrication and erection of fiberglass reinforced plastic (FRP) grating, including necessary accessories required for a complete installation as shown or specified.

1.02 REFERENCES

A. ASTM D 635. Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position

B. ASEM E 84. Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

Do not begin fabrication until after submittals have been approved. Submit the following for review.

A. Manufacturer's Product Data. Submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables, and design calculations for systems not sized or designed in the contract documents.

B. Shop Drawings. Drawings shall indicate thickness and spacing of bars, top surface treatment, color, hold-down clip, side clips, and the manufacturer's name and grating type. Show fabrication details, piece mark numbers and piece locations. Reproduction of design drawings for use as shop drawings will not be allowed.

C. Samples. Sample pieces of each item specified herein may be requested by the Engineer. Sample pieces shall be manufactured by the method to be used in the final production.

1.04 QUALITY ASSURANCE

A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.

B. Manufacturer shall offer a 3 year limited warranty on all FRP products against defects in materials and workmanship.

1.05 PRODUCT DELIVERY AND STORAGE

A. Tag each grating section with a removable weatherproof tag showing piece mark number corresponding with reviewed shop drawings.

B. Grating shall be protected during shipping and storage to prevent finish scratches, nicks, gouges or dents. Damaged material shall be replaced without additional cost to the Owner.

PART 2 - P R O D U C T S

2.01 MANUFACTURER

Acceptable manufacturers include Fibergrate Composite Structures and Strongwell.

2.02 MATERIALS

A. Grating.

1. Grating components shall be high strength and high stiffness pultruded elements having a maximum of 70% and a minimum of 60% glass content (by weight) of continuous roving and continuous strand mat fiberglass reinforcements. The finished surface of the product shall be provided with a surfacing veil to provide a resin rich surface which improves corrosion resistance and resistance to ultraviolet degradation. Bearing bars shall be interlocked and epoxied in place with a two piece cross rod system to provide a mechanical and chemical lock. Cross rods should be below the walking surface of the grating. Gratings with cross rods that are flush with the walking surface are excluded

2. Grating shall have a non-skid surface.

3. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84.

4. Resin system: Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating corrosion resistance and shall not be accepted

5. Color: Gray

6. Depth: The thickness shown on the drawings shall be the minimum depth. Grating manufacturer to confime depth against load and deflection requirements.

7. Design Criteria: Grating shall be capable of supporting the following minimum loads and deflection:
   a. A uniform live load of 100 psf or a concentrated load unless noted otherwise
   b. A concentrated force of 300 pounds at any location
   c. Maximum deflection under live load shall be span length/240 but not to exceed 0.25 inches.

8. Fiberglass grating shall be manufactured from premium grade, fire-retardant, thermosetting resin reinforced with fiberglass and constructed to provide complete wetting of the fiberglass by the resin.

9. Grating shall consist of straight parallel bearing I-bars placed edgewise and joined by solid crossbars on minimum 6-inch centers. The crossbars shall be epoxy bonded or equivalent at each bearing bar intersection.

10. Grating shall be resistant to the effects of sunlight and its ultraviolet radiation, rot, fungi, bacterial growth and adverse effects of acids, alkalies and residential and industrial waste.

11. Components shall be smooth and uniform without evidence of fiber orientation irregularities, interlaminar voids, porosity, resin-rich or resin-starved areas. Color shall be gray.

B. Clips and Bolts. Provide type 316 stainless steel saddle type clip hold-down fasteners and side panel clips with stainless steel bolts or studs. Self-drilling screws may be substituted for bolts or studs. Provide a minimum of two hold-down clips on each end of each piece of grating. For grating continuous over intermediate supports, provide a minimum of two hold-down clips at each intermediate support.

2.03 FABRICATION

A. Prior to fabrication, take field measurements of previously installed construction so that work will fit properly. Members that do not fit properly shall be replaced unless written approval for their modification has been obtained from the Engineer.

B. Form grating into sections of sizes indicated or as necessary for proper access and handling. Unless otherwise shown on the drawings, all panels shall be removable and shall not exceed 100 pounds in weight. Maximum width shall be 36 inches; maximum length shall be three spans. Provide for a maximum of 1/4-inch spacing between adjacent sections.

C. Grating shall span in the direction of the short span unless indicated otherwise.

D. Provide accurately cut openings in gratings to suit penetration of piping, equipment and other items of work. Where possible, grating shall be laid out so that openings are centered on a joint between adjacent sections of grating. Cutouts with dimensions of 4 inches or less may be made in the field.

E. Cuts shall be clean and smooth without fins, beads or other projections. Crossbars shall be cut off flush with the outside face of the bearing bar.

F. All cuts or sanded surfaces shall be liberally coated with resin containing air-inhibiting additives.

G. Banding of supported ends of grating will not be required; however, banding will be required at cutouts greater than 6 inches.

H. All shop fabricated grating cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

I. Provide abrasive nosing at edges of grating which form the top tread of stairs.

PART 3 - E X E C U T I O N

3.01 INSTALLATION

A. Install in accordance with reviewed shop drawings. Grating shall fit on seats and support beams without binding or rocking. Fasten grating with hold-down clips as specified and detailed. Where required, sides of adjacent panels shall be tied together, with removable clips, to prevent differential deflections between adjacent panels.

B. Installation Tolerances. Crossbars and bearing bars of adjacent panels shall align. After installation, there shall be no more than 1/4-inch clearance between panels. All bearing bars shall be parallel.

3.02 PROTECTION

After installation, the grating shall be protected as necessary to prevent damage during completion of the contract. Damaged material shall be replaced without additional cost to the Owner.

END OF SECTION

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SECTION 06640

PLASTIC PANELING

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Fiberglass reinforced plastic (FRP) paneling for wall, including trim accessories.

B. Related Requirements:

   1. Section 06100 "Rough Carpentry" for wood furring for installing plastic paneling.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For Fiberglass reinforced plastic (FRP) paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

A. Testing Agency: .Acceptable to authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.

1. Basis of Design Basis of Design Product: Subject to compliance with requirements provide Crane Composites, Inc.; FM Approved “Glasbord FXE” Class A Fiberglass Reinforced Plastic (FRP) Panels or comparable product by one of the following:

a. Marlite
b. Newcourt, Inc.
c. Nudo Products, Inc.
d. Parkland Plastic, Inc.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.090 inch.
4. Surface Finish: Pebbled embossed texture.
5. Color: As selected by Architect from manufacturer's full range.

B. Performance Criteria (Class A Panels):
1. Scratch Resistance, ASTM D 2583, Barcol Hardness: 55.
2. Abrasion Resistance, Taber Abrasion Test, CS-17 abrasive wheels with 1,000 g weight: Weight loss after 25 cycles of no more than 0.038 percent.
3. Barcol Hardness: 45, ASTM D2583.
4. Impact Strength, ASTM D 5420: 11.0 in-lbs (0.58 J), showing no visible damage on finish side. Water Absorption: 0.16 percent in 24 hours at 77 deg F (25 deg C), ASTM D570.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Match panels.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer and with a VOC content of 50g/L or less.

E. Sealant: Mildew-resistant, single-component, neutral-curing silicone or mildew-resistant, single-component, neutral-curing or acid-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

1. Sealant shall have a VOC content of 250 g/L or less.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels] so that trimmed panels at corners are not less than 12 inches wide.

1. Mark plumb lines on substrate at panel joint locations for accurate installation.
2. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.

1. Drill oversized fastener holes in panels and center fasteners in holes.
2. Apply sealant to fastener holes before installing fasteners.

D. Install factory-laminated panels using concealed mounting splines in panel joints.

E. Install trim accessories with adhesive. Do not fasten through panels.

F. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

SECTION 07110

DAMPPROOFING AND WATERPROOFING

PART 1 - G E N E R A L

1.1 WORK INCLUDES

A. Hot-applied asphalt dampproofing, exterior surfaces of below grade concrete walls.

B. Cold-applied, cut-back asphalt dampproofing, exterior surfaces of below grade concrete walls.

C. Cold-applied, asphalt emulsion dampproofing, exterior surfaces of below grade concrete walls.

D. Cementitious slurry capillary (crystalline) waterproofing, exterior exposed-to-view surfaces of concrete walls.

E. Polymer-Modified Cement Waterproofing for wastewater treatment facilities, water retaining structures and concrete tanks.

1.2 REFERENCE STANDARDS

A. ASTM C 109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (use 2 in (50 mm) Cube Specimens.

B. ASTM C 321: Standard Test Method for Bond Strength of Chemical-Resistant Mortars.

C. ASTM C 348: Standard Test Method for Flexural Strength of Hydraulic Cement Mortars.

D. ASTM C 596: Standard Test Method for Drying Shrinkage of Mortar Containing Portland Cement.

E. ASTM C 944: Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method.

F. ASTM D41: Asphalt Primer Used in Roofing, Dampproofing and Waterproofing.

G. ASTM D43: Creosote Primer Used in Roofing, Dampproofing, and Waterproofing.

H. ASTM D449: Asphalt Used in Dampproofing and Waterproofing.

I. ASTM D450: Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing.

J. ASTM D491: Asphalt Mastic Used in Waterproofing.

K. ASTM D2822: Asphalt Roof Cement.

L. ASTM D4022: Coal Tar Roof Cement.

M. COE CRD-C 48: Method of Test for Water Permeability of Concrete; US Army Corps of Engineers.

N. NRCA Waterproofing Manual - National Roofing Contractors Association

O. NSF/ANSI Standard 61: Drinking Water System Components – Health Effects (for use of waterproofing material on structures holding potable water).

1.3 SUBMITTALS

A. Submit under provisions of Section 01330.

B. Product Data: Provide data for each type of product specified, including data substantiating that materials comply with requirements for each dampproofing material specified. Include recommended method of application, recommended primer, number of coats, coverage and thickness, and recommended protection course.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

D. Dampproofing manufacturer shall provide Certification that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer who has completed bituminous dampproofing similar in material, design, and extent to that indicated for this Project and with a documented 5-year minimum record of successful in-service performance.

B. Work required in conjunction with the cementitious slurry capillary waterproofing shall be conducted by an organization which specializes in waterproofing.

C. Single-Source Responsibility: Primary dampproofing materials and primers shall be supplied from one source and by a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

D. Perform Work in accordance with NRCA Waterproofing Manual.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Substrate: Proceed with dampproofing only after substrate construction and penetrating work have been completed.

B. Weather Limitations: Proceed with dampproofing only when existing and forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements.

C. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing had thoroughly cured.

PART 2 - P R O D U C T S

2.1 ACCEPTABLE MANUFACTURERS

A. Hot-Applied Asphalt Dampproofing.

1. W. R. Meadows, Inc.

2. Owens-Corning Fiberglas Corp.

3. Or approved alternative.

B. Cold-Applied, Cut-Back Asphalt Dampproofing.

1. ChemRex, Inc; Sonneborn Building Products Division
2. Karnak Chemical Corporation
3. W. R. Meadows, Inc.
4. Or approved alternative.

C. Cold-Applied, Asphalt Emulsion Dampproofing.

1. ChemRex, Inc. - Sonneborn Building Products Division
2. Euclid Chemical Company
3. Karnak Chemical Corporation
4. Koppers Industries, Inc.
5. W. R. Meadows, Inc.
6. Or approved alternative.

D. Cementitious Slurry Capillary (Crystalline) Waterproofing.

1. Xypex Chemical Corporation
2. Vandex (USA), Inc.
3. W.R. Meadows, Inc.
4. Aquafin, Inc.
5. Or approved alternative.

E. Polymer-Modified Cement Waterproofing for wastewater treatment facilities, water retaining structures and concrete tanks.

1. CEM-KOTE FLEX ST, By Gemite Products, Inc.
2. Or approved alternative.

2.2 BITUMINOUS DAMPPROOFING

A. Hot-Applied Asphalt Dampproofing: Comply with ASTM D 449, Type I.

B. Cold-Applied, Cut-Back Asphalt Dampproofing: Asphalt and solvent compound mixed to a smooth, uniform consistency to provide a firm, moisture-resistant, vapor-resistant, elastic coating recommended by the manufacturer for dampproofing use when applied according to the manufacturer's instructions.

1. Semimastic Grade: Asphalt roof coating, consisting of an asphalt base with petroleum solvents and mineral stabilizers, complying with ASTM D 4479, Type I.

2. Spray Grade: Asphalt roof coating, consisting of an asphalt base with petroleum solvents and no mineral fibers, complying with ASTM D 4479, Type I.

C. Cold-Applied, Asphalt Emulsion Dampproofing: Asphalt-based emulsions recommended by the manufacturer for dampproofing use when applied according to the manufacturer's instructions.

1. Semimastic Grade: Emulsified asphalt semimastic, prepared with mineral-colloid emulsifying agents and containing fibers other than asbestos, complying with ASTM D 1227, Type III or IV.

2. Spray Grade: Emulsified asphalt, prepared with mineral-colloid emulsifying agents without fibrous reinforcement, complying with ASTM D 1227, Type III.

2.3 CEMENTITIOUS SLURRY CAPILLARY (CRYSTALLINE) WATERPROOFING

A. Materials for Cementitious Slurry Capillary (Crystalline) Waterproofing: Blend of rapid hardening Portland cement, specially treated quartz sand, and activating chemicals having the following properties:

1.	Color:	Cement gray
2.	Aggregate:	Powder
3.	Compressive Strength (ASTM C109)	>3,000 psi at 28 days
4.	Flexural Strength (ASTM C348)	>700 psi at 28 days
5.	Adhesion/Bond (ASTM C321)	>220 psi at 28 days
6.	Shrinkage (ASTM C596)	-0.02% at 28 days

7. Permeability (CRD-C 48-92) No measurable leakage through waterproofed concrete, when tested at 460 feet water head (200 psi), positive or negative water pressure

8. Water (NSF/ANSI 61): Clean, clear, non-alkaline and free of salts and other harmful elements; potable.

2.4 WATERPROOFING PREPACKAGED, POLYMER-MODIFIED CEMENT WATERPROOFING

A. Positive-Side, Polymer-Modified Cement Waterproofing: Manufacturer's proprietary blend of dry cementitious and other ingredients for mixing with polymer admixture to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade, is breathable, resists negative-side hydrostatic pressure, and has properties complying with or exceeding the criteria specified below.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AQUAFIN, Inc.
b. BASF Corporation.
c. Euclid Chemical Company (The); an RPM company.
d. Gemite Products Inc.
e. International Chem-Crete, Inc.
f. Sika Corporation.
g. SpecChem, LLC.

1. Water Permeability: Maximum zero for water at 30 feet (9 m) when tested according to COE CRD-C 48.
2. Compressive Strength: Minimum 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C109/C109M.
3. Flexural Strength: Minimum 710 psi (4.8 MPa) at 28 days when tested according to ASTM C348.
4. Bond Strength: Minimum 220 psi (1.5 MPa) at 14 days when tested according to ASTM C321.
5. Color: As selected by Architect from full range.

2.5 ACCESSORY MATERIALS

B. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections and compatible with substrate and other materials indicated.

C. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.

D. Portland Cement: ASTM C150/C150M, Type I.

E. Slurry-Coat Sand: ASTM C144.

F. Trowel-Coat Sand: ASTM C33/C33M, fine aggregate.

G. Protective-Topping Sand: ASTM C144.

H. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and to not create a vapor barrier.

I. Water: Potable.

2.6 MIXES

A. Prepackaged, Polymer-Modified Cement Waterproofing: Add prepackaged dry ingredients to mixing liquid according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

2.7 MISCELLANEOUS MATERIALS

A. Asphalt-Based Dampproofing

1. Primer: Asphalt primer complying with ASTM D41, for asphalt-based dampproofing.

2. Glass Fabric: Woven glass fabric, treated with asphalt, complying with ASTM D1668, Type I.

B. Cementitious Slurry Capillary (Crystalline) Waterproofing

1. Fast Setting Patching Compound: Ready-mixed cementitious waterproofing and repair mortar recommended by waterproofing manufacturer for honeycombs, tie holes, seal strips (fillets/coves, reglets), etc.

a.	Compressive Strength (ASTM C109)	4,000 psi at 28 days
b.	Flexural Strength (ASTM C348)	800 psi at 28 days
c.	Shrinkage (ASTM C596)	0.04% at 28 days

2. Slow Setting Structural Patching Compound: Pre-blended, cementitious waterproofing and repair mortar recommended by waterproofing manufacturer larger repair areas.

a.	Compressive Strength (ASTM C109)	6,000 psi at 28 days
b.	Flexural Strength (ASTM C348)	1,160 psi at 28 days
c.	Adhesion/Bond (ASTM C321)	>225 psi at 28 days
d.	Shrinkage (ASTM C596)	0.023% at 28 days

3. Plugging Compound for Active Water Leaks: Crystalline technology enhanced accelerating agent for capillary (crystalline) waterproofing products or pulverized rapid-setting rubbing cement.

a.	Compressive Strength (ASTM C109)	2,800 psi at 24 hours
b.	Flexural Strength (ASTM C348)	320 psi at 24 hours

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

B. Verify items which penetrate surfaces to receive dampproofing are securely installed.

3.2 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing. Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

B. Clean substrate of projections and substances detrimental to work; comply with recommendation of prime materials manufacturer.

C. Do not apply dampproofing to surfaces unacceptable to manufacturer or applicator.

D. Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer, even though not shown.

E. Fill voids, seal joints, and apply bond breakers, if any, as recommended by prime materials manufacturer, with particular attention at construction joints.

F. Install separate flashings and corner protection stripping, as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirements at building expansion joints, if any.

G. Prime substrate as recommended by prime materials manufacturer.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's recommendations except where more stringent requirements are indicated and where Project conditions require extra precautions to ensure satisfactory performance of the work.

B. Hot-Applied Asphalt Dampproofing: Apply on exterior surfaces only.

C. Cold-Applied Asphalt Dampproofing:

1. For exterior surfaces, provide either emulsified or cut-back asphalt dampproofing materials, at Contractor's option.

2. For interior surfaces, provide only emulsified asphalt materials.

D. Reinforcement: At changes in plane or where otherwise shown as "reinforced", install lapped course of glass fabric in first coat of dampproofing compound before it thickens.

E. Bituminous Cant Strips: Install 2- by 2-inch cant strip of bituminous grout at base of vertical dampproofing where it meets horizontal surface.

F. Apply vertical dampproofing down walls from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when the Project is completed.

3.4 HOT-APPLIED ASPHALT DAMPPROOFING

A. Do not apply hot asphalt when substrate condition causes foaming.

B. Apply a coat of hot asphalt by mopping or spraying at a rate of 20 lb. or 2.5 gallons/100 square feet to produce a uniform film thickness of not less than 30 mils.

C. Apply a second coat, as specified, after allowing 24 hours for first coat to cure. Apply double thickness of second coat where first application has failed to produce a smooth, shiny, impervious coat.

3.5 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

A. Spray Grade:

1. Brush or spray apply a coat of dampproofing at a rate of 1.25 to 2 gallons/100 square feet, depending upon substrate texture, to produce a uniform, dry-film thickness of not less than 12 mils.

2. Apply a second coat, as specified above, after allowing 24 hours for first coat to dry. Apply second coat at a rate of 0.8 to 1.25 gallons/100 square feet. Apply double thickness of second coat where first application has failed to produce a smooth, shiny, impervious coat.

B. Semimastic Grade: Brush or spray apply a coat of dampproofing at a rate of 5 gallons/100 square feet to produce a uniform, dry-film thickness of not less than 30 mils.

C. Trowel Grade: Trowel apply a coat of mastic asphalt dampproofing onto substrate at a minimum rate of 7 gallons/100 square feet, to produce an average dry-film thickness of 70 mils but not less than 30 mils at any point.

3.6 COLD-APPLIED, ASPHALT EMULSION DAMPPROOFING

A. Spray Grade:

1. Brush or spray apply a coat of asphalt emulsion dampproofing at a rate of 1.5 to 2.5 gal./100 sq ft, depending upon substrate texture, to produce a uniform, dry-film thickness of not less than 15 mils.

2. Apply in 2 coats, if necessary, to obtain required thickness, allowing time for complete drying between coats.

B. Semimastic Grade: Brush or spray apply a coat of asphalt emulsion dampproofing at a rate of 5 gal./100 sq.ft., to produce a uniform, dry-film thickness of not less than 30 mils.

C. Trowel Grade: Trowel apply a coat of mastic asphalt emulsion dampproofing onto substrate at a minimum rate of 7 gal./100 sq. ft, to produce an average dry-film thickness of 60 mils but not less than 30 mils at any point.

3.7 CEMENTITIOUS SLURRY CAPILLARY WATERPROOFING

A. A technical representative of manufacturer shall be present on site during installation.

B. Environmental Conditions:

1. Temperature: Minimum 40˚F at the surface and the surrounding air for a minimum of 24 hours prior to initiating installation and 24 hours following the completion of the installation.

2. Moisture: Installation must be delayed in the event that the surface is wet or rain or snow is falling.

3. Surface: Apply to the surface only when it is free from dust, dirt, loose particles, cracks, grease, oil and other foreign matter that might affect the bond of the material to the concrete. Cleaning solutions shall be thoroughly removed before the start of the work. All unsatisfactory surfaces shall be etched and rinsed.

C. Mixing and application shall be in strict accordance with the written instructions of the manufacturer. This is to include surface preparation and patching.

D. Application Thickness:

1. Base Coat, one (1) coat using stiff bristle brush 1.5 lbs./sq.yd.

2. Final Coat, one (1) coat using trowel 1.5 lbs./sq.yd.

3. All vertical and horizontal intersections and construction joints, one (1) coat 2 lbs./sq.yd.

3.8 PROTECTION AND CLEANING

A. Protect exterior, below-grade dampproofing membrane from damage until backfill is completed. Remove overspray and spilled materials from surfaces not intended to receive dampproofing.

B. Premises shall be kept free from the accumulation of waste materials and rubbish at all times.

C. At the completion of installation, all tools, scaffolding, and surplus materials shall be removed from the area.

D. Protect cementitious slurry capillary waterproofing from sunlight, precipitation, and frost during the curing period of 14 days.

E. If required, moisture shall be supplied during the curing period.

F. Remove all waterproofing, dampproofing and caulking materials from all surfaces where materials are not required, so as to produce a clean, neat and workmanlike job.

2.7 WATERPROOFING PREPACKAGED, POLYMER-MODIFIED CEMENT WATERPROOFING

A. General: Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate surface with water for several hours and maintain damp condition until applying waterproofing. Remove standing water.
2. Apply waterproofing to surfaces, and extend waterproofing onto adjacent surfaces as follows:

a. Onto columns integral with treated walls.
b. Onto interior nontreated walls intersecting exterior treated walls, for a distance of 24 inches for cast-in-place concrete and 48 inches for masonry.
c. Onto exterior walls and onto both exterior and interior columns, for a height of 12 inches (300 mm), where floors, but not walls, are treated.
d. Onto every substrate in areas indicated for treatment, including pipe trenches,pipe chases,,pits,sumps,and,,similar offsets and features.

3. Number of Coats: Number required for specified water permeability.

a. Coating Thickness: Maximum application thickness of 47 mils (1.2 mm) per coat for total thickness or as required for specified water permeability.

b. Apply first coat as a slurry with brush or roller, and apply subsequent coats with brush, roller, spray, or trowel.
c. Vigorously work first coat onto the substrate, forcing the material into surface voids. Apply each subsequent coat into full contact with previous coat.
d. Allow manufacturer's recommended time between coats. Dampen surface between coats.

B. Final Coat Finish: Smooth troweled.

C. Curing: Cure waterproofing for not less than five days immediately after application and prior to being placed in service.

D. Curing: Moist-cure waterproofing for not less than three days immediately after application has set, followed by air drying prior to being placed in service unless otherwise recommended in writing by manufacturer.

2.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed application of waterproofing.

B. Prepare test and inspection reports.

3.9 SCHEDULE

A. Apply Asphalt Dampproofing to the following surfaces:

1. Exterior surfaces of below grade concrete walls.

2. Where indicated on the Drawings.

B. Apply Cementitious Slurry Capillary Waterproofing to the following surfaces:

1. Exterior, all exposed-to-view surfaces of concrete walls**.**

2. Where indicated on the Drawings.

C. Apply Polymer-Modified Cement Waterproofing to the following surfaces:

1. Exterior, exposed-to-view surfaces of water retaining structures and concrete tanks, where indicated on process drawings.

END OF SECTION

SECTION 07190

LIQUID WATER REPELLENT

PART 1 - G E N E R A L

1.1 SUBMITTALS

A. Manufacturer's literature, Material Safety Data Sheets, specifications and application instructions for water repellent materials.

B. Certification that installation temperatures are not less than 50°F or over 85°F unless otherwise authorized by manufacturer.

1.2 QUALITY ASSURANCE

A. Applicator shall submit evidence of a minimum 2 years' experience.

1.3 JOBSITE CONDITIONS

A. Environmental Requirements.
1. Do not proceed with application of materials when ambient temperature is less than 50°F.
2. Do not apply water repellent in rainy conditions or within 3 days after surfaces become wet from rainfall or other moisture.
3. Do not apply materials when low temperature of 40°F or less is predicted within a period of 24 hours after application.
4. Provide ventilation or forced air circulation during and after interior application of water repellent materials until all fumes are no longer evident.

B. Protection.
1. Protect plants and vegetation which might be affected by water repellent fumes or solvent materials.
2. Protect adjacent surfaces of aluminum and glass.

PART 2 - P R O D U C T S

2.1 WATER REPELLENT

A. Solvent-based, clear, filmless, non-yellowing, penetrating diffused crystalline quartz coating: "Chem-Trete BSM-40VOC" manufactured by Degussa, Series 662 "Prime-A-Roll Plus" by Chemprobe Corporation, "Weatherseal Siloxane" by ProSoCo, "Thorosiloxane 8S" by Thoro, or "Rainstopper 600" by Tex-Cote.

B. Basis of Design:
1. Sure Klean® Weather Seal Blok-Guar® & Graffiti Control II is a clear-drying, water-based silicone emulsion for weatherproofing concrete block and other porous masonry materials and protecting them from graffiti attacks without altering the natural appearance. Blok-Guar® & Graffiti Control II is appropriate for interior and exterior use. Blok-Guard® & Graffiti Control II protects exterior walls exposed to normal weathering. Graffiti removal from treated surfaces is fast and easy using Defacer Eraser Graffiti Remover.
2. Typical Technical Data:

a. Form: White liquid, slight odor.
b. Specific gravity: 1.00.
c. PH: not applicable.
d. Weight/Gallon: 8.32 pounds.
e. Active Content: 6 percent.
f. Total Solids: 6 percent ASTM D 2369.
g. VOC Content: less than 20 grams per Liter, Low Solids Coating. Complies with all known federal, state and district AIM VOC Standards.
h. Flash Point: greater than 212 degrees F ASTM D 3278.
i. Freeze Point: 32 degrees F (0 degrees C).
j. Shelf Life: 1 year in tightly sealed, unopened container.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine surfaces to receive water repellent treatment to assure conditions are satisfactory for application of materials.

B. Verify that masonry joints found to be unsound, hollow or otherwise defective have been raked out to a depth of 1/2 inch and pointed with mortar.

C. Verify that cracks which exceed 1/64 inch wide have been filled with pointing mortar.

D. Do not apply before joint sealants (Section 07920) have been installed and cured at least 48 hours.

E. Test a minimum 4 ft. by 4 ft. area on each type of masonry. Use the manufacturer's application instructions. Let protective treatment test area cure before inspection. Keep test panels available for comparison throughout the protective treatment project.

3.2 PREPARATION

A. New concrete or masonry walls must cure a minimum of 7 days before application of water repellent.

B. Clean surfaces to remove dust, dirt, oil, wax, efflorescence and other materials, in accordance with water repellent manufacturer's instructions.

C. Allow 3 days of drying time following rain or washing down of substrate surfaces.

3.3 APPLICATION

A. Apply water repellent with low pressure less than 50 psi airless fan spray nozzle with orifice no smaller than .018 inch to produce a continuous liquid spray. Do not fog or mist.

B. Before applying, read "Preparation" and "Safety Information" sections in the Manufacturer's Product Data Sheet. Refer to the Product Data Sheet for additional information about application product. Do not dilute or alter. Follow all manufacturer's recommendations for application.

C. Apply two coats of water repellent materials at rate recommended by manufacturer. Apply evenly until surface is saturated without rundown.

D. Start application at top of wall and work down surface, keeping a wet edge at all times.

E. Avoid letting water repellent dry between passes. Allow manufacturer recommended drying time before clean up.

3.4 FIELD QUALITY CONTROL

A. After water repellents have dried, spray coated surfaces with water.

B. Recoat surfaces that show water absorption. Surfaces that permit passage of water are unacceptable.

3.5 CLEANING

A. Clean spillage and overspray from adjacent surfaces as recommended by water repellent manufacturer.

END OF SECTION

SECTION 07215

SPRAYED THERMAL INSULATION

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Closed-Cell Spray Polyurethane Foam insulation.

B. Related Sections:

1. Section 04220, "Concrete Unit Masonry", for insulation installed in cavity walls and masonry cells.
2. Section 07210, "Thermal Insulation", for board insulation and blanket insulation.
3. Section 09260, "Gypsum Board"**,** for installation in metal-framed assemblies of insulation specified by referencing this Section.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Provide manufacturer’s data sheets, including preparation instructions and installation methods.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company with minimum three years of experience manufacturing specified products.
1. Product produced in an ISO 9001 registered factory.

B. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity, trained and certified by the manufacturer.

C. Mock-Up:
1. Construct mock-up, 4 feet long by 4 feet wide, including substrate construction.
2. Locate where directed.
3. If approved by Architect, mock-up may remain as part of the Work.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code requirements for flame and smoke ratings and non-combustibility as applicable.
   1. Applicable fire resistive design designations of inspecting and testing agency acceptable to authorities having jurisdiction.
   2. Chlorofluorocarbons (CFCs)/HCFCs: Products and equipment requiring or using CFCs or HCFCs during the manufacturing process shall not be permitted. Minimum thicknesses needed to achieve required fire resistance ratings of structural components and assemblies.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to foamed in-place insulation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products in protected area not exposed to weather and at temperature conditions recommended by manufacturer.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace foamed in-place insulation that fails in materials or workmanship within specified warranty period.

   1. Warranty Period: Limited Lifetime Warranty for life of the building.

PART 2 - P R O D U C T S

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.4 lb/cu. ft and minimum aged R-value at 1-inch thickness of 6.5 deg F x h x sq. ft./Btu at 75 deg F.
   1. Air Permeance (for 1 inch of material): ASTM E 283: <0.02 L/s.m2 @75 Pa.
   2. Water Vapor Transmission (for 1.5 inches of material): ASTM E 96; 0.9 perms.

B. Basis of design: Icynene MD-C-200 Closed cell spray Foam. Subject to compliance with requirements, provide one of the following:
   1. CertainTeed, CertaSpray Closed Cell Foam.
   2. Johns Manville, Closed –Cell Polyurethane Foam.
   3. BASF, Spraytite insulation.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

D. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify that substrate and cavities are free of any foreign material that will impede application.

C. Verify that other work on and within spaces to be insulated is complete prior to application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. Remove foreign materials, dirt, grease, oil, paint, laitance, efflorescence, and other substances that will affect application.

C. Mask and protect adjacent surfaces from overspray or damage.

3.3 APPLICATION

A. Apply insulation in accordance with manufacturer's written application instructions. Apply insulation to a uniform density without voids.

B. Apply to minimum cured thickness as indicated on the Drawings or as scheduled at the end of this Section.

C. Apply to minimum cured thickness as scheduled on Drawings.

D. Apply insulation to fill voids around doors and windows. Apply insulation to fill voids around accessible service and equipment penetrations.

E. Apply insulation to seal voids at truss ends to prevent wind scouring of ceiling insulation.

F. Seal plumbing stacks, electrical wiring and other penetrations into attic to control air leakage.

G. Apply insulation to fill voids around bathtubs to point of accessibility.

H. Apply insulation in unvented roof spaces and cathedral ceiling areas.

I. Where building is designed to meet the specific airtightness standards of the Energy Star Program, apply insulation as recommended by manufacturer to provide airtight construction. Apply sealant to joints between structural assemblies as specified in Division 7.

J. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Thickness and density.

C. Insulation will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 PROTECTION

A. Do not permit subsequent work to disturb applied insulation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 CONSTRUCTION WASTE MANAGEMENT

A. Plan and coordinate the insulation work to minimize the generation of offcuts and waste. Reuse insulation scraps to the maximum extent feasible.

B. Separate and recycle waste materials in accordance with the Waste Management Plan and to the extent economically feasible.

END OF SECTION

SECTION 07545

THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Self-adhering, thermoplastic polyolefin (TPO) roofing system.
3. Vapor retarder.
4. Roof insulation.

B. Related Requirements:

1. Section 06100 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 07710 "Roof Specialties" for manufactured copings and roof edge flashings.
3. Section 07920 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:

1. Roof membrane and flashings, of color required.
2. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturer and testing agency.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field Test Reports:
1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in Texas Department of Insurance Product Evaluation Index, UL listed, and listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, vapor retarder, and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Peak Wind Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, and, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - P R O D U C T S

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Minimum uplift -Class 90. Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
1. Zone 1 (Roof Area Field): as indicated Pre-cast Concrete Building shop drawings.

2.
3. Zone 2 (Roof Area Perimeter): as indicated in Pre-cast Concrete Building shop drawings.
4. Zone 3 (Roof Area Corners): as indicated in Pre-cast Concrete Building shop drawings.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: SH.

E. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 64 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

H. Texas Department of Insurance: Roof assembly shall be installed in accordance to TDI product Evaluation RC-274 as selected by windstorm consultant.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

A. TPO Sheet: ASTM D 6878/D 6878M, internally fabric- or scrim-reinforced, self-adhering TPO sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Firestone Building Products.
b. GenFlex Roofing Systems.
2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer.
3. Thickness: 60 mils (1.5 mm), nominal.
4. Exposed Face Color: White.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

F. Ballast Retaining Bar: Perimeter securement system consisting of a slotted extruded-aluminum retention bar with an integrated compression fastening strip.

1. Fasteners: 1-1/2-inch (38-mm) stainless steel fasteners with neoprene washers.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer, approved for use in FM Approvals' RoofNav-listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Carlisle SynTec Incorporated.
    b. Firestone Building Products.
    c. GAF.
    d. GenFlex Roofing Systems.
    e. Johns Manville; a Berkshire Hathaway company.
2. Compressive Strength: 20 psi (138 kPa).
3. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm) as recommended by manufacturer to meet performance criteria.
4. Thickness:
    a. Base Layer: 2-5/16 inches (58.42 mm).
    b. Upper Layer: 2-5/16 inches (58.42 mm).
5. Minimum required R-Value: 25.0.

2.5 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours after performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. 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.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072726 "Fluid-Applied Membrane Air Barriers."

3.4 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Wood Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows.

    a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    d. 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 (610 mm).

        1) Trim insulation so that water flow is unrestricted.

    e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    g. Loosely lay base layer of insulation units over substrate.

2. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood decks.

    a. Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
    b. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

3. Install upper layers of insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

        1) Trim insulation so that water flow is unrestricted.

    f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    h. Loosely lay each layer of insulation units over substrate.
    i. 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:

        1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
        2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 SELF-ADHERING ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer.

1. Stagger end laps.

E. Fold roof membrane to expose half of sheet width's bottom surface.

1. Remove release liner on exposed half of sheet.
2. Roll roof membrane over substrate while avoiding wrinkles.

F. Fold remaining half of roof membrane to expose bottom surface.

1. Remove release liner on exposed half of sheet.
2. Roll roof membrane over substrate while avoiding wrinkles.

G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

H. Apply roof membrane with side laps shingled with slope of roof deck where possible.

I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity.
2. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
3. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
4. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.6 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.8 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.9 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner**>.
2. Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Acceptance Date: _____.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

    a. lightning;
    b. peak gust wind speed exceeding <**Insert mph (m/sec)**>;
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. vapor condensation on bottom of roofing; and
    g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION

SECTION 07710

ROOF SPECIALTIES

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Related Requirements:
1. Section 06100 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07720 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
3. Section 07920 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

C. Samples: For each type of roof specialty and for each color and texture specified.

D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

E. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
2. Include copings, roof-edge specialties, roof-edge drainage systems, reglets and counterflashings made from 12-inch (300-mm) lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of roof specialty.

C. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.

D. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.

B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing".

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge as shown on Drawings.
2. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Section 014000 "Quality Requirements".
3. Build mockup of typical roof edge, including fascia, gutter and downspout, approximately 10 feet (3.0 m) long, including supporting construction, seams, attachments and accessories.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing".

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - P R O D U C T S

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install copings and roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

C. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Architectural Products Company.
b. ATAS International, Inc.
c. Berridge Manufacturing Company.
d. Castle Metal Products.
e. Cheney Flashing Company.
f. Drexel Metals.
g. Exceptional Metals.
h. Merchant and Evans.
i. Metal-Era, Inc.
j. OMG, Inc.
k. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
l. Perimeter Systems; a division of SAF.
m. SAF (Southern Aluminum Finishing Company, Inc.).

2. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.040 inch (1.02 mm) thick minimum or thickness as required to meet performance requirements.

a. Surface: Smooth, flat finish.
b. Finish: Three-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

3. Corners: Factory mitered and continuously welded.
4. Coping-Cap Attachment Method: Snap-on or face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.

a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches (300 mm) wide, with integral cleats.
b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet or stainless steel.

2.3 ROOF-EDGE SPECIALTIES

A. Canted Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on or compression-clamped metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a

continuous formed galvanized-steel sheet cant, 0.028 inch (0.71 mm) thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Architectural Products Company.
    b. ATAS International, Inc.
    c. Berridge Manufacturing Company.
    d. Castle Metal Products.
    e. Cheney Flashing Company.
    f. Drexel Metals.
    g. Merchant and Evans.
    h. Metal-Era, Inc.
    i. OMG, Inc.
    j. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
    k. SAF (Southern Aluminum Finishing Company, Inc.).

2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.040 inch (1.02 mm) thick or thickness as required to meet performance requirements.

    a. Surface: Smooth, flat finish.
    b. Finish: Three-coat fluoropolymer.
    c. Color: As selected by Architect from manufacturer's full range.

3. Corners: Factory mitered and continuously welded.
4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
5. Fascia Accessories: Fascia extenders with continuous hold-down cleats, Wall cap and Soffit trim.

B. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Berridge Manufacturing Company.
    b. Drexel Metals.
    c. Exceptional Metals.
    d. Fabral.
    e. Metal-Era, Inc.
    f. OMG, Inc.
    g. Perimeter Systems; a division of SAF.

2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.040 inch (1.02 mm) thick minimum or thickness as required to meet performance requirements.

    a. Surface: Smooth, flat finish.
    b. Finish: Three-coat fluoropolymer.
    c. Color: As selected by Architect from manufacturer's full range.

3. Corners: Factory mitered and continuously welded.
4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
5. Receiver: Aluminum sheet, 0.050 inch (1.27 mm) thick.
6. Special Fabrications: Cove fascia cover.

7. Fascia Accessories: Fascia extenders with continuous hold-down cleats, Wall cap and Soffit trim.

2.4 ROOF-EDGE DRAINAGE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Architectural Products Company.
2. ATAS International, Inc.
3. Berger Building Products, Inc.
4. Castle Metal Products.
5. Cheney Flashing Company.
6. CopperCraft by FABRAL.
7. Drexel Metals.
8. Exceptional Metals.
9. Merchant and Evans.
10. Metal-Era, Inc.
11. OMG, Inc.
12. Perimeter Systems; a division of SAF.
13. SAF (Southern Aluminum Finishing Company, Inc.).

B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (3.6 m), with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
1. Aluminum Sheet: 0.050 inch (1.27 mm) thick.
2. Gutter Profile: Style A according to SMACNA's "Architectural Sheet Metal Manual."
3. Embossed Surface: Embossed with design As selected by Architect from manufacturer's full range.
4. Applied Fascia Cover (Concealed Gutter): Exposed, formed aluminum, 0.040 inch (1.02 mm) thick, with factory-mitered corners, ends, and concealed splice joints.
5. Corners: Factory mitered and continuously welded.
6. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
7. Gutter Accessories: Continuous screened leaf guard with sheet metal frame.

C. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: 0.040 inch (1.02 mm) thick.

D. Splash Pans: Fabricate from the following exposed metal:
1. Formed Aluminum: 0.040 inch (1.02 mm) thick.

E. Aluminum Finish: Three-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

2.5 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berridge Manufacturing Company.
2. Castle Metal Products.
3. Cheney Flashing Company.

4. Drexel Metals.
5. Exceptional Metals.
6. Fry Reglet Corporation.
7. Heckmann Building Products, Inc.
8. Keystone Flashing Company, Inc.
9. Metal-Era, Inc.
10. OMG, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
1. Formed Aluminum: 0.050 inch (1.27 mm) thick.
2. Corners: Factory mitered and continuously welded.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:
1. Formed Aluminum: 0.032 inch (0.81 mm) thick.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Zinc-Coated Steel Finish: Three-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

F. Aluminum Finish: Three-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

2.6 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

C. Aluminum Extrusions: ASTM B221 (ASTM B221M), alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

D. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.

B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Galvanized-Steel Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A755/A755M and coating and resin manufacturers' written instructions.
   a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

E. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

F. Aluminum Extrusion Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum and stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.3 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.
2. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

3.4 ROOF-EDGE SPECIALITIES INSTALLATION

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.5 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches (305 mm) apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.2 m) apart. Install expansion-joint caps.
2. Install continuous leaf guards on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

D. Splash Pans: Install where downspouts discharge on low-slope roofs]. Set in elastomeric sealant.

3.6 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07720

ROOF ACCESSORIES

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Gravity ventilators.
5. Pipe and duct supports.
6. Pipe portals.
7. Preformed flashing sleeves.

1.3 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

D. Delegated-Design Submittal: For roof curbs, equipment supports and walkways indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - P R O D U C T S

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind-Restraint Performance: as compliant with jurisdiction enforced codes.

2.2 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: as required for equipment and compliant with existing enforced codes.

D. Material: Aluminum-zinc alloy-coated] steel sheet, 0.079 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.

E. Material: Aluminum sheet, 0.125 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.

F. Material: Stainless-steel sheet, 0.078 inch thick.

1. Finish: Manufacturer's standard.

G. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
6. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
8. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.
9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
12. Security Grille: Provide for all units.
13. Damper Tray: Provide damper tray or shelf with opening 3 inches less than interior curb dimensions indicated of size indicated.

2.3 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced perimeter or Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed structure-mounting flange at bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: as required for equipment and compliant with existing enforced codes.

D. Material: Aluminum-zinc alloy-coated steel sheet, 0.079 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.

E. Material: Aluminum sheet, 0.125 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.

F. Material: Stainless-steel sheet, 0.078 inch thick.

1. Finish: Manufacturer's standard.

G. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
4. Nailer: Factory-installed continuous wood nailers 5-1/2 inches wide [on top flange of equipment supports, continuous around support perimeter.
5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
9. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.
10. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.
11. Security Grille: Provide for all units.

2.4 GRAVITY VENTILATORS

A. Low-Profile, Cylindrical-Style Gravity Ventilators: Manufacturer's standard, fabricated as indicated, with manufacturer's standard welded or sealed mechanical joints.
   1. Construction: Integral base flange, vent cylinder, cylinder bird screen, and rain cap, hood.
   2. Dimensions: As indicated on Drawings.
   3. Configuration: As indicated on Drawings.
   4. Bird Screens: Manufacturer's standard mesh with rewireable frame.
   5. Insect Screens: Manufacturer's standard mesh with rewireable frame.
   6. Security Grille: Provide for all units.
   7. Vent Cylinder, Base Flange, and Rain-Cap, Hood Material: Stainless-steel sheet, of manufacturer's standard thickness.
   8. Finish: As selected by Architect from manufacturer's full range.

B. Louvered Penthouse-Style Gravity Ventilators: Manufacturer's standard, fabricated as indicated, with manufacturer's standard welded or sealed mechanical joints.
   1. Construction: Integral frame with base flange, weathertight cap with white translucent acrylic dome, and weatherproof sidewall louvers.
   2. Dimensions: As indicated on Drawings.
   3. Configuration: As indicated on Drawings.
   4. Bird Screens: Manufacturer's standard mesh with rewireable frame.
   5. Insect Screens: Manufacturer's standard mesh with rewireable frame.
   6. Security Grille: Provide for all units.
   7. Frame, Base Flange, Cap, and Louver Material: Stainless-steel sheet, of manufacturer's standard thickness.
   8. Finish: As selected by Architect from manufacturer's full range.

C. Turbine-Style Gravity Ventilators: Manufacturer's standard, fabricated as indicated, with manufacturer's standard welded or sealed mechanical joints:
   1. Provide integral weathertight base cap, outlet duct, and rotating louvered turbine.
   2. Throat Size and Height: As indicated on Drawings.
   3. Configuration: As indicated on Drawings.
   4. Bird Screens: Manufacturer's standard mesh with rewireable frame.
   5. Insect Screens: Manufacturer's standard mesh with rewireable frame.
   6. Security Grille: Provide for all units.
   7. Weathertight Base Cap, Outlet Duct, and Turbine Material: Manufacturer's standard sheet, of manufacturer's standard thickness.
   8. Finish: As selected by Architect from manufacturer's full range.

2.5 PIPE AND DUCT SUPPORTS

A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2-inch-diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

B. Fixed-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand with stainless-steel roller carrying assembly accommodating up to 7-inch- diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

C. Adjustable-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand base, pipe support, and roller housing, with stainless-steel threaded rod designed for adjusting support height, accommodating up to 18 inch diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or

deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

D. Adjustable-Height Structure-Mounted Pipe Supports: Extruded-aluminum tube, filled with urethane insulation; 2 inches in diameter; accommodating up to 7-inch-diameter pipe or conduit, with provision for pipe retainer; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, stainless-steel roller and retainer, and extruded-aluminum carrier assemblies; as required for quantity of pipe runs and sizes.

E. Curb-Mounted Pipe Supports: Galvanized steel support with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom; with adjustable-height roller-bearing pipe support accommodating up to 20-inch-diameter pipe or conduit and with provision for pipe retainer; as required for quantity of pipe runs and sizes.

F. Duct Supports: Extruded-aluminum, urethane-insulated supports, 2 inches in diameter; with manufacturer's recommended hardware for mounting to structure or structural roof deck.
   1. Finish: Manufacturer's standard.

2.6 PIPE PORTALS

A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.

B. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.

2.7 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted or perforated metal collar.

   1. Metal: Aluminum sheet, 0.063 inch thick.
   2. Diameter: As indicated on Drawings.
   3. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

   1. Metal: Aluminum sheet, 0.063 inch thick.
   2. Height: 13 inches.
   3. Diameter: As indicated on Drawings.
   4. Finish: Manufacturer's standard.

2.8 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.

   1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.

2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

4. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.

1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
2. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

3. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
3. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
4. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
5. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

6. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

7. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

D. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

E. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

F. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

G. Steel Tube: ASTM A 500/A 500M, round tube.

H. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.

I. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.9 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.

C. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.

D. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.

E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

F. Security Grilles: 3/4-inch diameter, ASTM A 1011/A 1011M steel bars spaced 6 incheso.c. in one direction and 12 inches o.c. in the other; factory finished as follows:

1. Surface Preparation: Remove mill scale and rust, if any, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.
3. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer; selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats under prolonged exposure.

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

H. Underlayment:

1. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.

3. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
4. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
5. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
6. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
7. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

I. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

J. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

K. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

L. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Gravity Ventilator Installation: Verify that gravity ventilators operate properly and have unrestricted airflow. Clean, lubricate, and adjust operating mechanisms.

F. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.

1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

G. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

H. Security Grilles: Weld bar intersections and, using tamper-resistant bolts, attach the ends of bars to structural frame or primary curb walls.

I. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09900 " Paints and Coatings."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07840

FIRESTOPPING

PART 1 - G E N E R A L

1.1 SUMMARY

A. Provide firestopping to seal and protect all penetrations, openings and joints occurring in fire-rated construction to prevent the passage of smoke and fumes and restore the fire rating of the assembly.

1.2 SUBMITTALS

A. Approval. Submit evidence of compliance with requirements of paragraph 1.03A below.

B. Product Data. Manufacturer's product data, and Material Safety Data Sheets for all products proposed for use. Include data identifying fire resistive properties and substantiating compliance with required fire ratings.

C. Details. Provide specific installation instructions and details for each job condition that requires firestopping.

D. Certification. Upon substantial completion, General Contractor shall provide certification that approved materials were installed in accordance with manufacturer's instructions and details.

1.3 QUALITY ASSURANCE

A. Installer. All firestopping shall be performed by a single firm trained or approved by one of the named manufacturers, and with at least 2 years experience as a firestop installation contractor.

B. Systems. Firestop systems shall meet requirements of UL 1479 or ASTM E 814, "Standard Method of Fire Tests of Through Penetration Firestops," tested assemblies that provide a fire rating equal to that of the construction being penetrated.

C. Manufacturer. All trades shall use products of the same manufacturer insofar as practical.

D. Circumstances. For those firestop applications that exist for which no UL tested system is available through any manufacturer, a manufacturer's engineering judgement derived from similar UL system designs or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Provide specific products listed below, or approved substitutions manufactured by Grace Construction Products, Hilti Construction Chemicals, Inc., International Protective Coatings Corporation, 3M Fire Protection Products, Rectorseal ("Metacaulk"), Inc., Specified Technologies, Inc., or Tremco.

2.2 MATERIALS

A. Provide firestop systems with “T” and “F” ratings as determined by UL 1479 or ASTM E 814 which are equal or higher than the ratings of construction being penetrated.

B. Provide manufacturer-approved anchoring devices, sleeves, etc., required for installation.

C. Use water-based, nontoxic firestop materials in lieu of silicone or solvent based materials wherever possible. Asbestos, lead and PCB content is not allowable.

2.3 FIRESTOPPING FOR PIPE AND CONDUIT PENETRATIONS

A. Two-part, expand-in-place silicone foam: CTC PR-855 “Chase Foam” as manufactured by Chase Technology Corporation, Huntington Station, New York; or approved substitution. At masonry walls or interior partitions, Contractor may use Nelson FSP Firestop Putty as manufactured by Nelson Electric, P.O. Box 726, Tulsa, Oklahoma, in lieu of silicone foam. Tremco “Fyre-Shield” or 3M “FireDam 150” one-component sealant may be used in lieu of foam or putty at the Contractor’s option.

B. The above fire seal is for use with metallic pipe and conduit only. Nonmetallic and plastic pipe and conduit shall be firestopped with a UL-rated intumescent putty compound, or approved firestop collar.

C. Penetrations containing loose electrical, data or communications cabling shall be protected using firestopping systems that allow unrestricted cable changes without damage to the seal.

D. Firestop material for piping penetrations by plumbing and sprinkler systems shall be moisture resistant.

2.4 FIRESTOPPING AT DUCT PENETRATIONS

A. Provide sheet metal retaining angles and sleeves, sealants, tape and duct access doors as required by the authorities having jurisdiction for installation of fire dampers at all duct passages through fire-rated walls or floors.

B. Fire dampers are specified and installed as a part of Division 15.

C. Annular spaces (if any) shall be sealed similar to Article 2.3.

2.5 FIRESTOPPING AT EXTERIOR WALLS

A. At openings between curtain wall and floor slab edges, provide 4-inch thick “Thermafiber Safing Insulation” manufactured by Thermafiber LLC, “FBX Safing Insulation” by Fibrex Corporation, “FireTemp Wrap” by Johns-Manville, or Tremco “Tremstop Acrylic” over mineral wool, or approved substitution.

B. To inside faces of spandrels above and below floor slab, apply semi-rigid foil-faced “Thermafiber Curtain Wall Insulation,” or approved substitution, thickness as shown on drawings.

C. “Thermafiber Smoke Seal Compound,” or approved substitution.

2.6 FIRESTOPPING OF CONSTRUCTION JOINTS

A. Seal joints between masonry or precast panels, expansion joints, and joints between tops of masonry walls and underside of floor slabs in fire resistive construction with a fire-resistive joint sealant system of fire endurance rating equal to that of required construction.

B. Joint sealing system shall be Fire-Resistive Joint Sealing System manufactured by Tremco of Cleveland, Ohio, using Johns-Manville "Cerablanket-FS" fire retardant filler, closed-cell polyethylene foam backup strip and Tremco "Dymeric 511" two-part sealant, Specified Technologies, Inc. "Pensil 300" silicone sealant, or approved substitution by manufacturers listed in Article 2.1.

2.7 FIRESTOPPING JOINTS IN CONCRETE PRECAST WALLS

A. Provide 2-hour rated joints at all tilt-up walls. Joints shall have 1-inch wide maximum opening and shall be constructed in accordance with UL design No. U900A using the following elements:
1. Tremco, Inc., "Dymonic" or approved substitution sealant bearing UL classification marking and installed to 1/2-inch thickness at interior and exterior of joint.
2. Ceramic fiber blanket of 6.5 pcf density folded to fill joint to 1-1/2-inch thickness at exterior.
3. Foamed polyethylene backing rod used at interior.
4. Ten-gauge steel plate and metal expansion fasteners to cover interior face of joint in accordance with UL design U900A.

PART 3 - E X E C U T I O N

3.1 GENERAL

A. Clean surfaces to receive fire safing of dirt, grease, loose material and other matter which may affect fire resistance or bond of fire safing material.

B. Read product and material safety data sheets and manufacturer's installation instructions. Comply with recommendations for ventilation and eye and skin protection.

C. Discard any material whose shelf life has expired.

D. Do not proceed with installation of firestop materials when temperature or humidity exceeds the manufacturer's recommended limitations for installation printed on product labels and product data sheets. Provide forced-air ventilation if recommended by manufacturer.

E. Provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

3.2 FIRESTOPPING AT DUCT PASSAGES

A. Install in accordance with requirements described in the Houston Building Code.

3.3 PIPING AND CONDUIT SEAL

A. Properly form and dam floor and wall penetrations with fire-resistive mineral composition board prior to preparing sealant.

B. Prepare and thoroughly mix foam sealant in strict accordance with manufacturer's instructions using powered mixer where quantities permit to assure maximum expansion ratio.

C. Inject mixed sealant into clean, dry, properly formed and dammed penetration openings and allow to cure for a minimum of 24 hours before removing damming materials. Provide adequate ventilation in work area during mixing and curing in accordance with manufacturer's instructions.

D. Two or more pipes or conduits grouped together and passing through the same penetration must be separated from one another to ensure complete coverage of foam sealant all around each individual pipe or conduit.

E. Two-hour rated seal may be achieved by:
   1. 1-1/2-inch minimum depth of sealant.
   2. 1/2-inch sealant bead over 3-inch depth of mineral wool.

3.4 FIRESTOPPING AT EXTERIOR WALLS

A. Apply safing insulation of proper size on safing clips spaced not to exceed 12-inch o.c. maximum between walls and floor slabs to the full depth of floor slab, leaving no voids.

B. Attach storefront insulation to exterior wall by impaling on mechanical fasteners adhered to wall at 12-inch o.c. maximum and securing with metal clinch shields or discs. Foil facing shall be towards building interior. Butt ends and edges of insulation closely together and fill all voids.

C. Apply Smoke Seal minimum 1/2 inch deep at floor level, atop safing.

3.5 FIRESTOPPING OF CONSTRUCTION JOINTS

A. Install joint sealing systems as shown on drawings or, if not shown, as required to achieve necessary fire rating.

B. Fold and insert in joint fire-retardant filler blanket of depth required by fire resistance rating to be maintained. Install backer rod and sealant.

C. Where sealant is to be applied directly to joint without backer rod, apply bond breaker to surface of filler blanket first to prevent adhesion of sealer to blanket.

3.6 FIRE RATED JOINTS IN CONCRETE PRECAST WALLS

A. Install in accordance with requirements of UL design No. U900A using fastenings and appurtenances of type, size and interval specified therein.

3.7 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur. Leave finished work in neat, clean condition with no evidence of spillovers or damage to adjacent surfaces.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

3.8 FIELD QUALITY CONTROL

A. Inspection. Work shall not be concealed until it has been inspected and approved by the applicable authorities.

B. Labeling.
   1. Identify the firestopping system that has been installed as being a “Rated Through-Penetration Firestop System C Do Not Disturb.”
   2. Use label, minimum 3 inches by 5 inches, yellow and black OSHA colors with manufacturer and contractor clearly identified, in concealed locations.

END OF SECTION

SECTION 07920

JOINT SEALANTS

PART 1 - G E N E R A L

1.1 SUMMARY

A. Provide joint sealants, backer material and accessories to ensure a complete and durable weathertight seal at all exterior surfaces and at other locations indicated.

1.2 SUBMITTALS

A. Evidence of Compliance. With Article 1.03.

B. Product Data. Submit manufacturer's relevant product data, Material Safety Data Sheets, and installation instructions for each material proposed and color samples of each type of material.

C. Certification. Manufacturer's certification that their products are suitable for the use intended and comply with the requirements of this Section.

D. Field Samples. Install minimum 36-inch joint of each type and color using personnel who will be assigned to the project to demonstrate appearance and workmanship. Do not proceed with installation until mock-up is approved.

E. Warranty. In compliance with Article 1.04.

1.3 QUALITY ASSURANCE

A. Manufacturer. Obtain elastomeric materials only from manufacturers who will, if required, send a qualified technical representative to the project site, for the purpose of advising the installer of proper procedures and precautions for the use of the materials.

B. Installer. A firm with a minimum of 3 years of successful experience in the application of the types of materials required, and who employs only skilled tradesmen for the work.

1.4 EXTENDED WARRANTY

A. Submit a written warranty agreeing to replace sealants which fail, within 5 years from date of substantial completion of the project, to perform as airtight and watertight joints, or fail in adhesion, cohesion, abrasion resistance, stain resistance, extrusion resistance, migration resistance, color retention or general durability.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Provide specific products listed below or approved substitution manufactured by Dow Corning, General Electric, Pecora, Sonneborn, Tremco or Morton International.

2.2 MATERIALS

A. General.
1. Provide manufacturer's standard colors as selected by Architect/Engineer for all exposed materials.
2. Before purchase of each specified sealant, confirm its compatibility with the joint surfaces, joint fillers and other materials in the joint system. Provide only materials known to be fully compatible with the actual installation conditions as shown by manufacturer's published data or certification. See paragraph 1.03B above.
3. Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   a. Sealants: 250 g/L.
   b. Primers for nonporous substrates: 250 g/L.
   c. Primers for porous substrates: 775 g/L.

B. Sealant for Exposed Vertical Working Joints. For all joints not exceeding 1-1/2 inches in width, such as expansion joints in masonry, control joints, perimeters of openings and other locations shown on drawings as sealant: Dow-Corning "790," "Silpruf" by GE, Pecora "864," "Thiokol 1P" by PolySpec, "Spectrem 1" by Tremco, or approved substitution complying with ASTM C 920, Type S, Grade NS, Class 25. Type M sealants (multi-component) such as "Thiokol 2P" by PolySpec are also acceptable.

C. Sealant for Horizontal and Sloped Traffic Surfaces. Sealants shall have a Shore A hardness between 25 and 50, shall accommodate plus-or-minus 25 percent joint movement, and shall comply with ASTM C 920, Type S or M, Grade P or NS, Class 25.

D. Sealant for Concealed Working Joints. For air and water seal such as bedding of sill units of openings: products listed in paragraph B above or Dow Corning "791," "Spectrem 3" by Tremco, or approved substitution complying with ASTM C 920, Type S, Grade NS.

E. Sealant for Non-working Interior Joints. "Tremflex 834" or "Tremsil 200" by Tremco, or approved mildew-resistant substitution complying with ASTM C 834.

F. Sealant for Structural Glass Joints. Dow Corning "795", Tremco "Spectrem 2", or approved substitution complying with ASTM C 920, Type S, Class 25, Grade NS, neutral cure.

G. Sealant for Continually Immersed or NSF Approved Joints. Morton International T-2235-M Sealant, Tremco "Vulkem" or approved substitution complying with ASTM C 920, Type M, Class 25, Grade NS, and certified to NSF Standard 61, Section 6 for Joining and Sealing Materials.

H. Cleaners and Primers/Sealers. Types as recommended by sealant manufacturers.

I. Backer Rods. Compressible rod stock of closed-cell polyethylene foam, butyl rubber foam or neoprene foam, compatible with type of sealant provided. Provide size and shape that will control the joint depth for sealant placement, break bond of sealant at the bottom of joint, form optimum shape of sealant bead on back side and provide a highly compressible backer to minimize the possibility of sealant extrusion when joint is compressed. Use bond breakers as recommended by sealant manufacturer and where backer rod cannot be used.

J. Masking Tape. Non-staining, non-absorbent tape compatible with sealants and adjacent (masked) materials.

K. Compressible Filler. "PolySeal" by Sandell Manufacturing Company, "Willseal 600" by Illbruck Sealant Systems, Inc., Minneapolis, Minnesota, or pre-compressed "BackerSeal" by EmSeal. Do not use in locations exposed to direct sunlight.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Installer shall examine joint surfaces, backing and anchorage of units forming sealant rabbet and the conditions under which the sealant work is to be performed. Notify the Contractor in writing of conditions detrimental to the proper performance of the sealants. Do not proceed with the sealant work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above the manufacturer's recommended limitations for installation. Proceed with the work only when weather forecast is favorable for proper cure and development of high early bond strength.

3.2 JOINT SURFACE PREPARATION

A. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture or other substances which would interfere with bond of sealant.

B. For elastomeric sealants, do not proceed with installation over painted surfaces, or surfaces waterproofed or treated with water repellent or other treatment or coating unless a laboratory test for durability (adhesion) in compliance with Paragraph 4.3.9 of FS TT-S-00227 or ASTM C 794-80 has successfully demonstrated that the sealant bond is not impaired by the coating or treatment. If the laboratory test has not been performed, or shows bond interference, remove coating or treatment. Mask adjacent surfaces and prime when recommended by sealant manufacturer.

3.3 INSTALLATION

A. Comply with manufacturer's printed instructions except where otherwise noted or specified. Install no material that has exceeded its shelf life.

B. In working joints, install backer rod at least 33 percent greater in diameter than joint width.

C. Employ only proven installation techniques that will ensure that sealants are deposited in uniform continuous ribbons without gaps or air pockets with complete "wetting" of the joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjacent surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

D. Install sealant to depths as shown or, if not shown, as recommended by the following general limitations, measured at the center (thin) section of the bead.
   1. For walks, paving and similar joints sealed with elastomeric sealants and subject to traffic and other indentation and abrasion exposures, fill joint to 75 percent of joint width, but not more than 5/8 inch deep or less than 3/8 inch deep.
   2. For normal moving joints sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
   3. For joints sealed with non-elastomeric sealants, fill joints to a depth range of 75 percent to 125 percent of joint width.

E. Sill Mastic. Bed sills in a trowel coat of specified sealant.

F. Spillage.
   1. Do not allow sealants to overflow or spill onto adjoining surfaces including rough textures. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces by sealants.

2. Remove masking tape immediately after joints have been tooled.
3. Remove excess and spillage of sealants on non-porous surfaces such as aluminum or glass promptly as the work progresses. Clean the adjoining surfaces without damage to surfaces or finishes.
4. To remove excess sealants from porous substrates such as concrete or stone, allow the sealant to cure first. Then lightly abrade or scrape the surface to remove the excess sealant without damaging the substrate surface.

G. Compressible Filler. Install where called for on drawings. Use properly sized pieces such that filler does not protrude beyond adjacent finished surfaces. Installed material shall be compressed to approximately 1/2 of its relaxed dimension.

3.4 CURE AND PROTECTION

A. The installer shall advise the Contractor of procedures for curing and protection of sealants during the construction period. Cure sealants in compliance with manufacturer's instructions and installer's recommendations to obtain high early bond strength, early cohesive strength and surface durability.

3.5 FIELD TESTING

A. Furnish a trained inspector to perform ASTM C 1521 testing on field samples, and on final installation. Submit test reports and plan of remedial action, if any.

END OF SECTION

SECTION 08255

FRP DOORS AND FRAMES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Fiberglass reinforced polyester (FRP) flush doors with FRP frames.

1.2 RELATED SECTIONS

A. Section 08710 - Door Hardware.

B. Section 08800– Glass and Glazing

1.3 REFERENCES

A. AAMA 920-11 – Specification for Operating Cycle Performance of Side-Hinged Exterior Door Systems.

B. AAMA 1304 - Voluntary Specification for Forced-Entry Resistance of Side-Hinged Door Systems.

C. ASTM C 1363-97 – Thermal Test Method for the Thermal Performance of Building Assemblies.

D. ASTM D 1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics

E. ASTM D 1761-06 – Standard Test Methods for Mechanical Fasteners in Wood.

F. ASTM D 6670-01 - Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products.

G. ASTM E 84-11 – Standard Method of Test for Surface Burning Characteristics of Building Materials.

H. ASTM E 283-04 – Test Method for Determining Rate of Airflow Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.

I. ASTM E 330-02 – Test Method for Structural Performance of Exterior Windows, Curtain Walls, Doors by Uniform Static Air Pressure Difference.

J. ASTM E 331-00 – Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

K. ASTM E 1886-05 – Test Method for Performance of Exterior Windows, Curtain Wall, Doors and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differential.

L. ASTM E 1996-06 – Test Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance

requirements, as demonstrated by testing manufacturer's corresponding standard systems.

B. Thermal Performance: Per ASTM C 1363-97, R-value 7.42.

C. Indoor air quality testing per ASTM D 6670-01: GREENGUARD Environmental Institute Certified including GREENGUARD for Children and Schools Certification.

D. Air Infiltration: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 283 at pressure differential of 6.24 psf. Door shall not exceed 0.09 cfm/ft^2.

E. Water Penetration: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 331. Door shall not have water leakage.

F. Uniform Load Structural: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 330: Plus or minus 270 psf.

G. Forced Entry Resistance, per AAMA 1304, Pass with No Entry.

H. Blast Test, Doors and Frames, ASTM F 1642-04, 6 psi / 41 psi-msec: No Hazard.

I. Large Missile Impact, Doors and Frames, ASTM E 1996, Pass.

J. Air Pressure Cycling, Doors and Frames, ASTM E 1886, Design Pressure Plus or Minus 100 psf, Pass with no rips, tears, or penetrations.

K. Cycle Test, AAMA 920-11, 2,000,000 Cycles.

L. Screw Pullout, ASTM D 1761-06, Minimum 924 pounds.

1.5 SUBMITTALS

A. Comply with Section 01330 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, finishes, and installation.

C. Shop Drawings: Submit manufacturer's shop drawings, including elevations, sections, and details, indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, and finish.

D. Samples:
1. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.
2. Color: Submit manufacturer's samples of standard colors of doors and frames.

E. Test Reports: Submit test reports from qualified independent testing agency indicating doors comply with specified performance requirements.

F. Manufacturer's Project References: Submit list of successfully completed projects including project name and location, name of architect, and type and quantity of doors manufactured.

G. Maintenance Manual: Submit manufacturer's maintenance and cleaning instructions for doors, including maintenance and operating instructions for hardware.

H. Warranty: Submit manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of 25 years successful experience.
   2. Door and frame components from same manufacturer.
   3. Evidence of a compliant documented quality management system.

B. Regulatory Requirements: Comply with requirements of Texas Department of Insurance (TDI). All exterior aluminum windows shall be pre-Approved by TDI, shall be impact resistant, and shall be engineered to withstand wind load indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish from damage during handling and installation.

1.8 WARRANTY

A. Warrant doors, frames, and factory hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.

B. Warranty Period: Ten years starting on date of shipment. In addition, a limited lifetime (while the door is in its specified application in its original installation) warranty covering: failure due to corrosion

PART 2 – P R O D U C T S

2.1 MANUFACTURERS

A. Basis of design: Special-Lite, Inc., PO Box 6, Decatur, Michigan 49045 or an equal TDI compliant product by Tiger Door, Plastpro, Inc. or CHEM-Pruf Door Co.,Ltd.

B. Texas Department of Insurance product evaluation: DR-715.

2.2 FRP FLUSH DOORS

A. Model: AF-100 Pultruded FRP Door.

B. Door Opening Size: As indicated on the Drawings.

C. Construction:
   1. Door Thickness: 1-3/4 inches.
   2. Construction: Doors shall be FRP, pultruded as one monolithic panel, with integral stiles.
   3. Reinforcement: Solid FRP shapes to be chemically welded at factory. All structural members shall utilize a chemically resistant UV stabilized resin system.
   4. Stile Edge: Seamless 9/16” thick solid FRP.
   5. Top Rail: 6” pultruded tube profile designed to fit flush and be chemically welded inside the door.
   6. Bottom Rail: Pultruded FRP inverted U channel designed to fit flush and be chemically welded inside the door, allowing doors to be field trimmed. Closed bottom rail to be supplied as an option.

D. Face Sheet:
1. Material: Pultruded FRP, 0.125-inch thickness.
2. Texture: Smooth.
3. Fiberglass Content: Minimum 47% by weight.
4. Color: as selected by architect from manufacturer standard colors.

E. Core:
1. Material: Polyurethane foam.
2. Density: Minimum of 6 pounds per cubic foot.
3. Per ASTM E 84 flame spread and smoke developed: Class B.

F. Cutouts:
a. Manufacture doors with cutouts for required vision lites, louvers, and panels.
b. Factory install vision lites, louvers, and panels.

G. Hardware:
1. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

2.3 MATERIALS

A. Components: Door and frame components from same manufacturer.

B. Fasteners:
1. Material: Aluminum, 18-8 stainless steel, or other noncorrosive metal.
2. Compatibility: Compatible with items to be fastened.

2.4 FABRICATION

A. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on the Drawings.

B. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.

C. Assembly:
1. Complete cutting, fitting, forming, drilling, and chemically welding of FRP before assembly.

D. Fit:
1. Maintain continuity of line and accurate relation of planes and angles.
2. Secure attachments and support at mechanical joints with hairline fit at contacting members.

2.5 FRP FRAMING SYSTEMS

A. Framing:
1. Size and Type: As indicated on the Drawings.
2. Materials: ¼” thick solid pultruded FRP profiles having no corrosive components or reinforcement.
3. Width: 2” face.
4. Depth: 7 ¾” or as indicated in drawings. Custom sizes available from 4 ½” to 12”.
5. Assembly: One piece chemically welded at factory.
6. Door Stop: 5/8” x 2 ¼”.
7. Corner Construction: Mitered with 4” x 4” x 3/8” pultruded FRP angle reinforcement with interlocking pultruded FRP brackets.
8. Reinforcing: ¼” pultruded FRP chemically welded at all hinge, strike and closer locations.
9. Mullions: Fixed Pultruded FRP Centerpost 2” x 5 ¾”.

10. Transom and Sidelites: Shall be same material as perimeter frame with removable stop for: 1" glass by others.
11. Anchors: Furnished with type as specified on drawings.
12. Fasteners for reinforcing: 18-8 Stainless Steel.

2.6 HARDWARE

A. Premachine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

B. Hardware Schedule: As specified in Section 08710.

2.7 VISION LITES

A. Factory Applied Stop for Glazing: 1-inch glass insulating units.

B. Lite Size:
1. Size: As indicated on the Drawings.

2.8 LOUVERS

A. Type: Pultruded FRP 1/8" thick materials. Fixed inverted "Y" shaped blades. Louver size as indicated on drawings. Finish shall match door.

B. Size: As indicated on the Drawings.

C. Installation: Factory installed into standard vision lite kit. Exterior side of louver shall be free of fasteners.

D. Insect screen:.Stainless Steel.

2.9 FINISH

A. Finish For Doors and Frames Primer with a finished color coat.
1. Painted Finish: Two-part aliphatic polyurethane, low VOC, Industrial Coating.
2. Thickness: 5 mils
3. Sheen: Gloss
4. Impact Resistance per ASTM D 2794: 140 in lbs.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Ensure openings to receive frames are plumb, level, square, and in tolerance.

3.3 INSTALLATION

A. Install doors in accordance with manufacturer's instructions.

B. Install doors plumb, level, square, true to line, and without warp or rack.

C. Anchor frames securely in place.

D. Set thresholds in bed of mastic and backseal.

E. Install exterior doors to be weathertight in closed position.

F. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

G. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for installation of doors.

3.5 ADJUSTING

A. Adjust doors, hinges, and locksets for smooth operation without binding.

3.6 CLEANING

A. Clean doors promptly after installation in accordance with manufacturer's instructions using a mild detergent and water.

3.7 PROTECTION

A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 08350

FOLDING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bi-fold metal doors, tested and approved for use in High Velocity Wind Zones, up to design pressure of 120psf.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for folding doors.

B. Shop Drawings:

   1. Include plans, elevations, sections, and installation details.
   2. Include clearances required for operation, operating and control mechanisms, access requirements, and accessory items.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For each type of exposed finish.

   1. Include Samples of hardware and accessories involving color and finish selection.

E. Product Schedule: For folding doors. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For doors and connections, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each impact resistant folding door, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For folding doors to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of impact resistant folding doors.

B. Qualification Data: For delegated-design professional engineer licensed in the State of Texas.

C. Doors shall be designed to withstand external or internal horizontal wind loads of 120 lbs. minimum psf. The maximum allowable deflection shall not exceed 1/120 of the span. Fiber stresses in main members shall be limited to 27,000 lbs. psi. Steel frames shall be designed in accordance with the AISC "Steel Construction Manual".

D. Doors shall meet all requirements listed on Texas Department of Insurance Product Evaluation ID: DR-1075.

E. Door manufacturer shall have at least 10 years of experience manufacturing door type specified for applications of similar type.

1.8 DELIVERY, STORAGE AND HANDLING

A. Store delivered materials and equipment in dry locations with adequate ventilation, free from dust and water; in such way as to permit access for inspection and handling.

B. Handle materials carefully to prevent damage.

1.9 MATERIALS: For Coastal installation tube frame members, and steel sheets shall be hot-dipped galvanized. All accessories shall be fabricated of non-corrosive compatible materials.

A. Steel Tube: ASTM A513 and ASTM A500/A500M

B. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A1011/A1011M hot-rolled steel sheet.

C. Hardware: Manufacturer's standard components.

D. Fasteners: Zinc-coated steel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain bi-fold doors from single source from single manufacturer.

1. Obtain operators and controls from door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Windborne-Debris Impact Resistance: Passes TAS 201/203-94, TAS 202-94 missile-impact for Wind Zone 3.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.

B. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal. Comply with requirements for windborne-debris resistance.

2.3 METAL BIFOLD DOORS

A. Description: Steel glazed bi-folding doors, impact resistant.

B. Products: Subject to compliance with requirements, provide one of the following:
1. BATOR North America LLC.: PO Box 36526, 1451 South Elm-Eugene Street, Greensboro, NC 27406 (336.907.2286) www.bator.com or equal.
2. Basis of Design: Classic Folding Door (Manual Operation).

C. Construction: Door framing shall be minimum 11-gauge structural steel tube with 14-gauge steel sheet on the exterior and interior faces. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces.

1. Door panels and optional glazing shall be sealed with wet silicone on exterior and interior side. All frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening by more than 1/8 inch in 20 feet.

2. Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.

3. If installation is within 50 miles of coast, tube frame members shall be hot-dipped galvanized. Door to be pinch proof design between section leafs.

D. Surface Mounted Tube Frame: Supply pre-hung tube frame system, designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports, and operator supports shall be factory attached.

E. Hardware: Manufacturer's standard guide tracks and brackets, trolleys, center guides, not less than three pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation.

F. Hinges: All hinges shall be welded on frame. Hinges are equipped with thrust bearings and grease nipples. All hinge pins shall be a minimum of 1" in diameter and made of stainless steel or hardened steel.

G. Insulation: Insulating material shall be mineral wool with a calculated R-value of 4.8.

H. Weather-stripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weather-stripping at center shall be 1/8" inserted neoprene and include no

exposed fasteners on the exterior face of the panel. Weather-stripping at sill shall include two 1/8" inserted neoprene sweeps without aluminum retainer.

I. Perimeter Weather-stripping: Provide jamb and head weather-stripping of 1/8" neoprene with double layer seal. Bulb seals are not acceptable.

J. Glazing:
1. Provide 1 3/16" impact resistant glass (1/4" CLTP 9/16" Air (SIL) 1/4" CLHS 180SG 1/4" CLHS) vision panels of the size, shape and location as noted on the plans.
2. Interlayer: 0.090" Sentryglas interlayer by Kuraray.

K. Finishes:

1. Factory-applied powder-coat finish for panels and hinges in colors as selected by Architect from manufacturer's full range.
2. Manufacturer's standard finish for all hardware.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. For folding doors supported by or anchored to permanent construction, advise installers of specific requirements for placement of anchorage devices. Furnish installers of other work with templates and drawings indicating locations of anchorage devices and similar items.

3.3 INSTALLATION

A. General: Install folding doors complying with manufacturer's written installation instructions.

B. Install Bi-Fold metal doors in strict accordance with the approved drawings by qualified door erection crews. All door openings shall be completely prepared by the general contractor prior to the installation of the doors.

C. Doors shall be set plumb, level, and square, and with all parts properly fastened and mounted. All moving parts shall be tested and adjusted and left in good operating condition.

D. Install all hardware in accordance with listed on Texas Department of Insurance Product Evaluation ID: DR-1075/Bator North America No. BNA002.

3.4 ADJUSTING

A. Adjust units to ensure smooth, quiet operation without warping or binding. Adjust hardware to function smoothly. Confirm that latches engage accurately and securely without forcing or binding.

1. Impact Resistant Folding Doors: Verify that all operations are functional and comply with requirements of authorities having jurisdiction.

B. Inspection of the doors and a complete operating test will be made by the installer in the presence of the general contractor or architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the general contractor must assume the responsibility for any damage or rough handling of the doors during construction until the building is turned over to the owner and final inspection is made.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain impact resistant folding doors.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 - G E N E R A L

1.1 SUMMARY:

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.

1. Door hardware for steel (hollow metal) doors.
2. Door hardware for aluminum doors.
3. Door hardware for wood doors.
4. Door hardware for other doors indicated.
5. Keyed cylinders as indicated.

B. Related Sections:
1. Division 6: Rough Carpentry.
2. Division 8: Aluminum Doors and Frames
3. Division 8: Hollow Metal Doors and Frames.
4. Division 8: Wood Doors.
5. Division 26 Electrical
6. Division 28: Electronic Security

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.

1. Builders Hardware Manufacturing Association (BHMA)
2. NFPA 101 Life Safety Code
3. NFPA 80-Fire Doors and Windows
4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
5. UL10C – Positive Pressure Fire Test of Door Assemblies
6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities 2009
7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
8. 2012 Texas Accessibility Standards (TAS)

D. Intent of Hardware Groups

1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

E. Allowances

1. Refer to Division 1 for allowance amount and procedures.

F. Alternates

1. Refer to Division 1 for Alternates and procedures.

1.2 SUBSTITUTIONS:

A. Comply with Division 1.

1.3 SUBMITTALS:

A. Comply with Division 1.

B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 6 copies of catalog cuts with hardware schedule.
5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
6. Mounting heights.
7. Explanation of abbreviations and symbols used within schedule.
8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.

F. Samples: (If requested by the Architect)

1. 1 sample of Lever and Rose/Escutcheon design, (pair).
2. 3 samples of metal finishes

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following.

a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.

c. Name, address, and phone number of local representative for each manufacturer.
d. Parts list for each product.

2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule
4. As installed “Wiring Diagrams” for each piece of hardware connected to power, both low voltage and 110 volts.
5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.
1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.

a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
b. Hardware Schedule shall be prepared and signed by an AHC.

4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.

a. Provide UL listed hardware for labeled and 45 minute openings in conformance with requirements for class of opening scheduled.
b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.

6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the

proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer's Warranty:

1. Closers: Ten years
2. Exit Devices: Three Years
3. Locksets & Cylinders: Three years
4. All other Hardware: Two years.

1.8 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.

1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - P R O D U CT S

2.1 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

Hinges	Stanley	Bommer, McKinney
Continuous Hinges	Stanley	Select, ABH
Locksets	Best	No Substitutions
Cylinders	Best	No Substitutions
Exit Devices	Precision	Von Duprin
Closers	Stanley QDC100	LCN 4040
Push/Pull Bars	Trimco	Burns, Rockwood
Protection Plates	Trimco	Burns, Rockwood
Overhead Stops	ABH	Rixson, Glynn Johnson
Door Stops	Trimco	Burns, Rockwood

Flush Bolts	Trimco	ABH, Burns
Coordinator & Brackets	Trimco	ABH, Burns
Threshold & Gasketing	National Guard	Reese, K.N. Crowder

2.2 MATERIALS:

A. Hinges: Shall be Five Knuckle Ball bearing hinges

1. Template screw hole locations
2. Bearings are to be fully hardened.
3. Bearing shell is to be consistent shape with barrel.
4. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
5. Equip with easily seated, non-rising pins.
6. Non-Removable Pin screws shall be slotted stainless steel screws.
7. Hinges shall be full polished, front, back and barrel.
8. Hinge pin is to be fully plated.
9. Bearing assembly is to be installed after plating.
10. Sufficient size to allow 180-degree swing of door
11. Furnish five knuckles with flush ball bearings
12. Provide hinge type as listed in schedule.
13. Furnish 3 hinges per leaf to 7-foot 6-inch height. Add one for each additional 30 inches in height or fraction thereof.
14. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
15. UL10C listed for Fire rated doors.

B. Geared Continuous Hinges:

1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Anti-spinning through fastener
3. UL10C listed for 3-hour Fire rating
4. Non-handed
5. Lifetime warranty
6. Provide Fire Pins for 3-hour fire ratings
7. Sufficient size to permit door to swing 180 degrees

C. Mortise Type Locks and Latches:

1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C.
2. Furnish UL or recognized independent laboratory certified mechanical operational testing to 4 million cycles minimum.
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Fit ANSI A115.1 door preparation
5. Functions and design as indicated in the hardware groups
6. Solid, one-piece, 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel
7. Deadbolt functions shall have 1-inch (25mm) throw bolt made of hardened stainless steel
8. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended
9. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated
10. Provide sufficient curved strike lip to protect door trim

11. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
12. Lock shall have self-aligning, thru-bolted trim
13. Levers to operate a roller bearing spindle hub mechanism
14. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
15. Spindle to be designed to prevent forced entry from attacking of lever
16. Provide locksets with 7-pin removable and interchangeable core cylinders
17. Each lever to have independent spring mechanism controlling it
18. Core face must be the same finish as the lockset.

D. Exit Devices with Weatherized True Architectural Finish 626W:

1. Exit devices to meet or exceed BHMA for ANSI 156.3, Grade 1.
2. Exit devices to be tested and certified by UL or by a recognized independent laboratory to meet or exceed the following:
   a. Mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
   b. BHMA 156.3 – A156.18 Salt Spray Certified 600 Hours 3 X Standard.
   c. MIL-STD-810G 509.6 Salt Fog Certified.
   d. MIL-STD-810G 510.6 Sand & Dust Certified.
   e. MIL-STD-810G 521.4 Icing/Freezing Rain Certified.
3. Exit devices chassis to be investment cast steel, zinc dichromate.
4. Exit devices to have stainless steel deadlocking ¾" through latch bolt.
5. Exit devices to be equipped with sound dampening on touchbar.
6. Non-fire rated exit devices to have cylinder dogging.
7. Non-fire rated exit devices to have ¼" minimum turn hex key dogging.
8. All Exterior components of the exit device including the Active case cover, Touch bar, device channel, slide channel fillers, Vertical rods, latch covers and device end cap, shall be constructed of a brass base metal then plated in a double dip two-step process of satin nickel and chrome.
9. Exit device shall be available with options of WTS Weatherized touch bar switch and WALW Weatherized Exit alarm (hardwired)
10. Additional non-weatherized electrified options are compatible with the 626W. Non-weatherized options are not recommended for harsh environments.
11. Touchpad to be "T" style constructed.
12. Touchbar assembly on wide style exit devices to have a ¼" clearance to allow for vision frames.
13. All exposed exit device components to be of architectural metals and "true" architectural finishes.
14. Provide strikes as required by application.
15. Fire exit hardware to conform to UL10C and UBC 7-2. UL tested for Accident Hazard.
16. The strike is to be black powder coated finish.
17. Exit devices to have field reversible handing.
18. Provide heavy duty vandal resistant lever trim with heavy duty investment cast stainless steel components and extra strength shock absorbing overload springs. Lever shall not require resetting. Lever design to match locksets and latchsets.
19. Provide 9001-Quality Management and 14001-Environmental Management.
20. Vertical Latch Assemblies to have gravity operation, no springs.
21. Approved Manufacturers
    a. The following manufacturers will be approved contingent on meeting or exceeding the above performance criteria:
       1) Precision with 626W finish, Manufactured by Stanley Security Solutions

E. Cylinders:

1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.

2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.

F. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles
5. Conform to ANSI 117.1
6. Maximum 2 7/16-inch case projection with non-ferrous cover
7. Separate adjusting valves for closing and latching speed, and backcheck
8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
9. Full rack and pinion type closer with 1-1/2-inch minimum bore
10. Mount closers on non-public side of door, unless otherwise noted in specification
11. Closers shall be non-handed, non-sized and multi-sized.

G. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.

1. Wall and floor stops shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

H. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.

1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
2. Surface overhead stops shall be heavy duty bronze or stainless steel.

I. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

J. Mop plates: Provide with four beveled edges ANSI J103, 4 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

K. Door Bolts: Flush bolts for wood or metal doors.

1. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.

L. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.

1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
2. Provide mounting brackets for soffit applied hardware.
3. Provide hardware preparation (cutouts) for latches as necessary.

M. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

N. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.

1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.

O. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.

1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.

P. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½" for conformance with TAS/ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

Q. Provide one wall mounted Telkee, Lund or MMF series key cabinet complete with hooks, index and tags to accommodate 50% expansion. Coordinate mounting location with architect.

R. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

2.3 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, removable and interchangeable core system: Existing Best CORMAX™ Patented 7-pin.

C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."

D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:

1. 2 each Grand Masterkeys
2. 6 each Masterkeys
3. 3 each Change keys each keyed core
4. 15 each Construction masterkeys
5. 2 each Control keys
6. 2 each Construction Control keys

F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.

1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).

2. Recommended locations for Architectural Hardware for flush wood doors (DHI).

3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.

1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.

2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

a. Verify levers are free from binding.
b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE:

Manufacturer List

Code	Name
AB	ABH Manufacturing Inc.
BE	Best Access Systems
BY	By Others
NA	National Guard
PR	Precision
SENT	Sentrol
SH	Stanley Commercial Hardware
ST	Stanley
TR	Trimco

Option List

Code	Description
CD	CYLINDER DOGGING
FL	Fire Exit Hardware
SN	Sex Nuts
CSK	COUNTER SINKING OF KICK and MOP PLATES
LBR	LESS BOTTOM ROD
MLR	MOTORIZED LATCH RETRACTION
RQE	REQUEST TO EXIT
VIB	Double Visual Indictor Option
WTDS	Weatherized Monitoring Double Switch
CA-03	Cylinder Attachment Kit (Rim/SVR Device)
B4E-HEAVY-AP	Beveled 4 edges - armor plates
B4E-HEAVY-KP	Beveled 4 edges - kick plates
1/4-20 SSMS/EA	Stainless machine screws/expansion anc.

Finish List

Code	Description
AL	Aluminum

626	Satin Chromium Plated
630	Satin Stainless Steel
689	Aluminum Painted
626W	Weatherized Satin Chrome
GREY	Grey
US28	Aluminum - Clear Anodized
BLACK	Black
US26D	Chromium Plated, Dull
US32D	Stainless Steel, Dull

Hardware Sets

SET #01 -

Doors: 201B

1	Cylinder(s) as Required Best I/C per Key Schedule		626	BE

NOTE: Hardware by door manufacturer. Refer to Section 08350 Folding Doors.

SET #02 -

Doors: 201A

3	Hinges	FBB199 5 X 4 1/2 NRP	US32D	ST
1	Storeroom Lock	45H-7D14H PATD	630	BE
1	Door Closer	QDC119 SN	689	SH
1	Kick Plate	K0050 10" x 34" B4E-HEAVY-KP CSK	630	TR
1	Drip Cap	16 A 40"	NA	
1	Gasketing	155 S 1 x 36" 2 x 84"	NA	
1	Door Sweep	200 NA 36"	NA	
1	Saddle Threshold	425 HD 36" 1/4-20 SSMS/EA	AL	NA

SET #13 -

Doors: 203

3	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST
1	Privacy Lock	45H-0L14H VIB	630	BE
1	Door Closer	QDC111 SN	689	SH
1	Kick Plate	K0050 10" x 34" B4E-HEAVY-KP CSK	630	TR
1	Mop Plate	KM050 4" x 35" B4E-HEAVY-AP CSK	630	TR
1	Wall Stop	1270WV	630	TR
1	Set of Gasketing	5050 B @ 17	NA	

SET #14 -

Doors: 202

3	Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST
1	Storeroom Lock	45H-7D14H PATD	630	BE
1	Door Closer	QDC111 SN	689	SH
1	Kick Plate	K0050 10" x 34" B4E-HEAVY-KP CSK	630	TR
1	Wall Stop	1270WV	630	TR
1	Set of Gasketing	5050 B @ 17	NA	

1	Door Sweep	200 NA 36"	NA	
1	Saddle Threshold	425 HD 36" 1/4-20 SSMS/EA	AL	NA

END OF SECTION

SECTION 08800

GLAZING

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites, and glazed storefront framing.
2. Glazing sealants and accessories.

B. Related Requirements:
1. Section 08810 "Fire-Rated Glass."

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of the following products; 12 inches square.

1. Tinted glass.
2. Coated glass.
3. Insulating Laminated glass.
4. Insulating glass.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: glass testing agency and sealant testing agency.

B. Fabricator qualifications: manufacturer certified fabricator.

C. Installer qualifications: an experience installer who has completed glazing similar material , design and extent to that indicated for this project, who employs glass installers for this project who are certified under National Glass Association Glazier Certification Program as level 2 (senior glaziers) or level 3 (Master Glaziers)

D. Product Certificates: For glass.

E. Product Test Reports: For tinted glass, coated glass, insulating glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

F. Preconstruction adhesion and compatibility test report.

G. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.12 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Subject to compliance with requirements , provide products by one of the following:
1. Old Castle Building Envelope, 5005 LBJ Freeway, Suite 1050, Dallas, TX 75244.
2. Viracon,, by Apogee's 4400 West 78th Street Suite 520 Minneapolis, MN 55435.
3. Solutia Saflex Architectural by Eastman 9155 South Dadeland Boulevard suite 1116 Miami Fl 33156.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.
2. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

D. Glazing product should be compatible with storefront or curtain wall system holding Texas Department of Insurance product evaluation.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, licensed to practice in the Texas.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E1300.

1. Design Wind Pressures: As indicated on Drawings.

2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

    a. Wind Design Data: As indicated on Structural Drawings.
    b. Basic Wind Speed: As indicated on Structural Drawings.
    c. Importance Factor: As indicated on Structural Drawings.
    d. Exposure Category: As indicated on Structural Drawings.

3. Design Snow Loads: As indicated on Structural Drawings.
4. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
5. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
6. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
7. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

8. Wall and Roof Zonal Wind Pressures; as defined on the drawings.

9. Protection Requirements for Glazed Openings.

    a. Glazing shall be protected with an impact-protective system or shall be impact-resistant glazing.
    b. Impact-protective systems and impact-resistant glazing shall be subjected to missile test and cyclic pressure differential tests in accordance with ASTM E1996 as applicable.
    c. Testing to demonstrate compliance with ASTM E1996 shall be in accordance with ASTM E1886.
    d. Impact-resistant glazing and impact-protective systems shall comply with the pass/fail criteria of Section 7 of ASTM E1996 based on the missile required by Table 3 or Table 4 of ASTM E1996 as required by authorities having jurisdiction.

D. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

E. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

F. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

G. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick of thickness indicated.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.

6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Ultraclear Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent and solar heat gain coefficient of not less than 0.87.

C. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.

D. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

E. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

F. Pyrolytic-Coated, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.

G. Ceramic-Coated Vision Glass: ASTM C 1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual."

H. Reflective-Coated Vision Glass: ASTM C 1376.

I. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, Quality-Q3.

J. Silicone-Coated Spandrel Glass: ASTM C 1048, Type I, Condition C, Quality-Q3.

K. Reflective-Coated Spandrel Glass: ASTM C 1376, Kind CS.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with one of the following to comply with interlayer manufacturer's written instructions:

1. Polyvinyl butyral interlayer.
2. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
3. Ionomeric polymer interlayer.
4. Cast-in-place and cured-transparent-resin interlayer.
5. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Spacer: Manufacturer's standard spacer material and construction.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
4. Sealants shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. Glass Type GL-1: Clear heat-strengthened float glass.

1. Minimum Thickness: 6 mm.

B. Glass Type GL-2: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

C. Glass Type GL-3: Clear Laminated float glass.

1. Minimum Thickness: 6 mm.

D. Interlayer material (pvb): 0.30inch.

E. Glass Type GL-4: Laminated glass.

1. Basis-of-Design Product: VIRACON Insulated Laminated VS-08#2
2. Overall Unit Thickness: 9/16 inch Minimum.
3. Thickness of Outdoor Lite: 1/4 inch .
4. Outdoor Lite: heat-strengthened float glass.
5. Tint Color: clear.
6. Indoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.
    a. Minimum Thickness of Each Glass Ply: 6 mm.
    b. PVB Interlayer Thickness: 0.090 inch.
7. Winter Nighttime U-Factor: 0.95 Btu (hr x sqft x °F).
8. Summer Daytime U-Factor: 0.86 Btu (hr x sqft x °F).
9. Visible Light Transmittance: 8 percent minimum.
10. Solar Heat Gain Coefficient (SHGC): 0.25 maximum.
11. Hurricane resistance performance required.

F. Glass Type GL-5: Monolithic Spandrel Glass

1. Basis-of-Design Product: Viraspan Monolithic Glass, Insulated Laminated VS-08#2 as manufactured by Viracon.
2. Overall Unit Thickness: 9/16 inch (14 mm) Minimum.
3. Thickness of Outdoor Lite: 1/4 inch (6 mm).

4. Outdoor Lite: Heat-strengthened float glass.
5. Ceramic Frit: Medium Gray V948 on #2 surface.
6. Indoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.

    a. Minimum Thickness of Each Glass Ply: 6 mm.
    b. PVB Interlayer Thickness: 0.090 inch .
7. Winter Nighttime U-Factor: 0.95 Btu (hr x sqft x °F).
8. Summer Daytime U-Factor: 0.86 Btu (hr x sqft x °F).
9. Visible Light Transmittance: 8 percent minimum.
10. Solar Heat Gain Coefficient (SHGC): 0.25 maximum.
11. Hurricane resistance performance required.

3.9 INSULATING LAMINATED GLASS SCHEDULE

A. Glass Type GL-6: Low-E-coated, tinted, insulating laminated glass.

1. Basis-of-Design Product: VIRACON Insulated Laminated VRE19-54
2. Overall Unit Thickness: 1-5/16 inch Minimum.
3. Thickness of Outdoor Lite: 1/4 inch.
4. Outdoor Lite: Tinted heat-strengthened float glass.
5. Tint Color: Crystal Gray.
6. Interspace Content: 1/2” Air.
7. Indoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.

    a. Minimum Thickness of Each Glass Ply:6 mm.
    b. PVB Interlayer Thickness: 0.090 inch.

8. Low-E Coating: Pyrolytic or sputtered on second surface.
9. Winter Nighttime U-Factor: 0.29 Btu (hr x sqft x °F).
10. Summer Daytime U-Factor: 0.27 Btu (hr x sqft x °F).
11. Visible Light Transmittance: 33 percent minimum.
12. Solar Heat Gain Coefficient (SHGC): 0.25.
13. Hurricane resistance performance required.

END OF SECTION

SECTION 09110

NON-LOAD-BEARING WALL FRAMING

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Requirements:

1. Section 05400 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: Submit evaluation reports certified under an independent third party inspection program administered by an agency accredited by IAS to ICC-ES AC98, IAS Accreditation Criteria for Inspection Agencies.

C. Manufacturers Certification: Submit manufacturer's certification of product compliance with codes and standards along with product literature and data sheets for specified products.

PART 2 - P R O D U C T S

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by, and displaying a classification label from an independent testing agency acceptable to the authority having jurisdiction.

1. Construct fire-resistance rated partitions in compliance with tested assembly requirements indicated on drawings.
2. Rated assemblies to be substantiated from applicable testing using proposed products, by Contractor.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).

D. Design framing systems in accordance with American Iron and Steel Institute Publication “S220 - North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members”, except as otherwise shown or specified.

E. Design loads: As indicated on the Architectural Drawings or 5 PSF minimum as required by the International Building Code.

F. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design loads with a maximum deflection of <insert number> inches.

2.2 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance program.

B. Contractor shall provide effective, full time quality control over all fabrication and erection complying with the pertinent codes and regulations of government agencies having jurisdiction. Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturer’s installation instructions.

2.3 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice".

2.4 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Non-Structural Studs: Cold-formed galvanized steel C-studs as per ASTM C 645 for conditions indicated below:

1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; ProSTUD 33 mil (20 STR) 33 ksi. products named below, or a comparable product from one of the members of the SFIA:
   1) Steel Network Inc.
   2) Telling Industries.
   3) MRI Steel Framing LLC.

2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), ASTM A 653/A 653M, G60 (Z180), Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated. Galvannealed products are not acceptable.

3. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to the authorities having jurisdiction.

C. Studs and Runners: ASTM C 645
1. Non-Structural Studs: Cold-formed galvanized steel C-studs as per ASTM C 645 for conditions indicated below:
   a. Minimum Base-Steel Thickness: 0.0329 inch (0.8382 mm).
   b. Minimum Design Thickness: 0.0346 inch (0.8788 mm).
   c. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

   a. Products: subject to compliance with requirements, that may be incorporated into the work include the following:
      1) ClarkDietrich Building Systems; BlazeFrame DL Deflection Track.
      2) Steel Network Inc.; VertiTrack VTD Series.
      3) Telling Industries; Vertical Slip Track II.

E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; BlazeFrame DSL or a comparable product from one of the members of the SFIA:
   a. Steel Network Inc.
   b. Telling Industries
   c. MRI Steel Framing LLC.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; Danback Fire-Retardant Treated Wood Backing Plate D16F, D24F, or a comparable product from one of the members of the SFIA:
   a. Steel Network Inc.
   b. Telling Industries.
   c. MRI Steel Framing LLC.

2. Minimum Base-Metal Thickness: 0.018 inch.

G. Channel Bridging and Bracing: Pre-notched steel, 7/8 inch by 7/8 inch by 50 inches, 0.0329-inch minimum base-steel thickness.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; Spazzer 9200 Bridging and Spacing Bar or a comparable product from one of the members of the SFIA:
      a. Steel Network Inc.
      b. Telling Industries.
      c. MRI Steel Framing LLC.
   2. Depth: 1-1/2 inches
   3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; Furring Channel or a comparable product from one of the members of the SFIA:
      a. Steel Network Inc.
      b. Telling Industries.
      c. MRI Steel Framing LLC.
   2. Minimum Base-Metal Thickness: 0.018 inch.
   3. Depth: 7/8 inch1-1/2 inches.

I. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; RC Deluxe (RCSD) Resilient Channel or a comparable product from one of the members of the SFIA:
      a. Steel Network Inc.
      b. Telling Industries.
      c. MRI Steel Framing LLC.
   2. Configuration: Asymmetrical.

J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.

   1. Depth: 3/4 inch
   2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; Z-Furring Channel or a comparable product from one of the members of the SFIA:
      a. Steel Network Inc.
      b. Telling Industries.
      c. MRI Steel Framing LLC.

L. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
      a. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; J-Tabbed Track, or a comparable product that meets or exceeds the requirements as stated in the 2012 International Building Code.

1) Steel Network Inc.
2) Telling Industries.
3) MRI Steel Framing LLC

2.5 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Post-installed, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.018 inch.
b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base-Metal Thickness: 0.018 inch.

4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong World Industries, Inc.

b. ROCKFON.
c. United States Gypsum Company.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 24 inches o.c. unless otherwise indicated.
2. Multilayer Application: 24 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches 600 mm o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 24 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members,

install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

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SECTION 09260

GYPSUM BOARD SYSTEMS

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

B. Related Requirements:
1. Section 09110 "Non-Load Bearing Wall Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.4 QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - P R O D U C T S

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond by National Gypsum Company or a comparable product from one of the following:
1. Certain Teed Corporation.
2. Georgia –Pacific Building Products.
3. United States Gypsum Company.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

D. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

E. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

F. Foil-Backed Gypsum Board: ASTM C 1396/C 1396M.

1. Core: As indicated on Drawings.
2. Long Edges: Tapered.

G. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 1.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: score of 10 as rated according to ASTM D 3273.

H. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond Fire Shield by National Gypsum Company or a comparable product from one of the following:
1. Certain Teed Corporation.
2. Georgia –Pacific Building Products.
3. United States Gypsum Company.
    a. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
    b. Long Edges: Tapered.

C. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond Exp Interior Extreme by National Gypsum Company or a comparable product from one of the following:
    a. Certain Teed Corporation.
    b. Georgia –Pacific Building Products.

c. United States Gypsum Company.

2. Core: 1/2 inch, regular type, 1/2 inch, Type C.
3. Long Edges: Tapered.
4. Mold Resistance: score of 10 as rated according to ASTM D 3273.

D. Acoustically Enhanced Gypsum Board: ASTM C 1396/C 1396M. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond Soundbreak XP by National Gypsum Company or a comparable product from one of the following:
a. Certain Teed Corporation.
b. Georgia –Pacific Building Products.
c. United States Gypsum Company.
2. Core: 5/8 inch, regular type, 5/8 inch, Type X
3. Long Edges: Tapered.
4. Mold resistance: score of 10 as rated according to ASTM D 3273.

E. Skim-Coated Gypsum Board: ASTM C 1396/C 1396M. Manufactured with a factory-applied skim coat.
1. Core: 1/2 inch, regular type, 5/8 inch, Type X.
2. Long Edges: Tapered.

2.5 GYPSUM SHEATHING

A. Exterior Gypsum Sheathing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond Gypsum Sheathing by National Gypsum Company or a comparable product from one of the following:
a. Certain Teed Corporation.
b. Georgia –Pacific Building Products.
c. United States Gypsum Company.

2. Core: 1/2 inch, regular type, 5/8 inch, Type X.

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond EXP extended exposure gypsum sheathing by National Gypsum Company or a comparable product from one of the following:
a. Certain Teed Corporation.
b. Georgia –Pacific Building Products.
c. United States Gypsum Company.
2. Core: 1/2 inch, regular type, 5/8 inch, Type X.

2.6 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond Exterior Soffit Board or Fire-Shield Exterior Soffit Board by National Gypsum Company or a comparable product from one of the following:
a. Certain Teed Corporation.
b. Georgia –Pacific Building Products.
c. United States Gypsum Company.

2. Core: 1/2 inch, regular type, 5/8 inch, Type X.

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond eXP extended exposure gypsum sheathing by National Gypsum Company or a comparable product from one of the following:
a. Certain Teed Corporation.
b. Georgia –Pacific Building Products.
c. United States Gypsum Company.
2. Core: 1/2 inch, regular type , 5/8 inch, Type X.

2.7 TILE BACKING PANELS

A. Fiberglass Mat-faced Mold and Moisture-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond eXP Tile Backer by National Gypsum Company or a comparable product from one of the following:
a. Certain Teed Corporation.
b. Georgia –Pacific Building Products.
c. United States Gypsum Company.
2. Core: 1/2 inch, regular type, 5/8 inch, Type X.
3. Mold Resistance: score of 10 as rated according to ASTM D 3273.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide PermaBase Cement Board by National Gypsum Company or a comparable product from one of the following:
a. Certain Teed Corporation.
b. Georgia –Pacific Building Products.
c. United States Gypsum Company.
2. Thickness: 5/8 inch
3. Compliance: with ASTM C 1325 and ANSI A 118.9.

2.8 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.

2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Basis-of-Design Product: Subject to compliance with requirements, provide products by Fry Reglet Corporation or a comparable product from one of the following:
    a. Gordon, Inc.
    b. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.9 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.10 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Gold Bond Fire Shield STI SpecSeal Smoke N Sound Caulk by Specified Technologies Inc. or a comparable product from one of the following:
   a. Accumetric LLC
   b. Grabber Construction Products.
   c. Hilti Inc.

2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Thermal Insulation: As specified in Section 07210 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 07270 “Fluid applied membrane air barrier”.

2.11 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E 84.

1. Basis-of-Design Product: Subject to compliance with requirements, provide ProForm Perfect Spray by National Gypsum; or a comparable product by one of the following:
   a. Georgia –Pacific Building Products.
   b. USG Corporation.

2. Texture: Fine.

C. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ProForm Perfect Spray EM by National Gypsum; or a comparable product by one of the following:
a. Georgia –Pacific Building Products.
b. USG Corporation.

2. Texture: Spatter knock-down.

D. Non-Aggregate Finish: Pre-mixed, vinyl texture finish for spray application.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ProForm Perfect Spray HF by National Gypsum; or a comparable product by one of the following:
a. Georgia –Pacific Building Products.
b. USG Corporation.

2. Texture: Orange Peel.

E. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.
1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
a. International Cellulose Corp.; SonaSpray "fc."
b. USG Corporation; USG Acoustical Plaster Finish.
2. Application Thickness: 1/2 inch
3. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

4. NRC: 0.55 according to ASTM C 423.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8 inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2 inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: Vertical surfaces unless otherwise indicated.
2. Type X: As indicated on Drawings and Where required for fire-resistance-rated assembly.
3. Flexible Type: Apply in double layer at curved assemblies.
4. Ceiling Type: Ceiling surfaces.
5. Foil-Backed Type: As indicated on Drawings.
6. Abuse-Resistant Type: As indicated on Drawings.
7. Moisture- and Mold-Resistant Type: As indicated on Drawings.
8. Type C: Where required for specific fire-resistance-rated assembly indicated.
9. Glass-Mat Interior Type: As indicated on Drawings.
10. Acoustically Enhanced Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) or horizontally (perpendicular to framing)] unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated and locations indicated to receive tile.

C. Water-Resistant Backing Board: Install where indicated with 1/4-inch gap where panels abut other construction or penetrations.

D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Bullnose Bead: Use at outside corners where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use at exposed panel edges and where indicated.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

E. Aluminum Trim: Install in locations indicated on Drawings.

3.7 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile, and Where indicated on Drawings.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

5. Level 5: Where indicated on Drawings.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.9 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09310

CERAMIC TILE

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ceramic mosaic tile.
2. Pressed floor tile.
3. Porcelain tile.
4. Glazed wall tile.
5. Stone thresholds.
6. Waterproof membrane for thinset applications.
7. Crack isolation membrane.
8. Metal edge strips.

B. Related Requirements:

1. Section 07140 " Fluid-Applied Waterproofing" for waterproofing under thickset mortar beds.
2. Section 07920 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Section 09260 "Gypsum Board" for cementitious backer units and glass-mat, water-resistant backer board.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: Tile on walkway surfaces shall be provided with the following values as determined by testing in conformance with ASTM C 1028.
   1. Level Surfaces: Minimum of 0.6 (Wet).
   2. Step Treads: Minimum of 0.6 (Wet).
   3. Ramp Surfaces: Minimum of 0.8 (Wet

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

D. Samples for Verification:

   1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least [12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
   3. Full-size units of each type of trim and accessory for each color and finish required.
   4. Stone thresholds in 6-inch lengths.
   5. Metal edge strips in 6-inch lengths.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

   2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Source Limitations for Tile: tile from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile Corporation, which is located at: 7834 C.F. Hawn Fwy. P. O. Box 170130; Dallas, TX or a comparable product from one of the following:
1. Lone Star Ceramics: Elgin Butler.
2. InterCeramic.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Waterproof membrane.
3. Crack isolation membrane.
4. Cementitious backer units.
5. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation on exteriors or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. Ceramic Tile Type CT-1: Porcelain floor tile.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Colorbody Porcelain Tile, product Continental Slate 12x12 by Dal -Tile TX or a comparable product from one of the following:
   a. Lone Star Ceramics: Elgin Butler.
   b. InterCeramic.

2. Composition: Porcelain.
3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
4. Module Size: 11 13/16 by 11 13/16 inches.
5. Thickness: 5/16 inch.

6. Face: Plain.
7. Surface: Slip resistant, with abrasive admixture.
8. Dynamic Coefficient of Friction: Not less than 0.42.
9. Finish: Mat, opaque.
10. Tile Color and Pattern: As selected by Architect from manufacturer's full range, pattern as shown on drawings.
11. Grout Color: As selected by Architect from manufacturer's full range.
12. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Cove Base: CTB-1, module size 6 by 12 inches, S-36C9T.
    b. Cove Base Outcorner: module size 1 by 6 inches, SC-36C9T.
    c. Bullnose: module size 3 by 12 inches, P-43C9.
    d. Internal Corners: Field-butted square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
    e. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

B. Ceramic Tile Type CT-2: Porcelain wall tile.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Colorbody Porcelain Tile, product Continental Slate 6x6 by Dal -Tile TX or a comparable product from one of the following:
    a. Lone Star Ceramics: Elgin Butler.
    b. InterCeramic.

2. Composition: Porcelain.
3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
4. Module Size: 5 13/16 by 5 13/16 inches.
5. Thickness: 5/16 inch.
6. Face: Plain.
7. Surface: Slip resistant, with abrasive admixture.
8. Dynamic Coefficient of Friction: Not less than 0.42.
9. Finish: Mat, opaque.
10. Tile Color and Pattern: As selected by Architect from manufacturer's full range, pattern as shown on drawings.
11. Grout Color: As selected by Architect from manufacturer's full range.
12. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Cove Base: CTB-1, module size 6 by 12 inches, S-36C9T.
    b. Cove Base Outcorner: module size 1 by 6 inches, SC-36C9T.
    c. Bullnose: module size 3 by 12 inches, P-43C9.
    d. Internal Corners: Field-butted square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
    e. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

C. Ceramic Tile Type CT-3: Factory-mounted glazed ceramic mosaic tile.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Colorbody Porcelain Tile, product Continental Slate 3 X 3 mosaic by Dal -Tile TX or a comparable product from one of the following:
    a. Lone Star Ceramics: Elgin Butler.

b. InterCeramic.

2. Composition: Porcelain.
3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
4. Module Size: 1 15/16 x 9 inches.
5. Thickness: 1/4 inch.
6. Face: Plain.
7. Surface: Slip resistant, with abrasive admixture.
8. Dynamic Coefficient of Friction: Not less than 0.42.
9. Finish: Mat, opaque.
10. Tile Color and Pattern: As selected by Architect from manufacturer's full range, pattern as shown on drawings.
11. Grout Color: As selected by Architect from manufacturer's full range.
12. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Cove Base: CTB-1, module size 6 by 12 inches, S-36C9T.
    b. Cove Base Outcorner: module size 1 by 6 inches, SC-36C9T.
    c. Bullnose: module size 3 by 12 inches, P-43C9.
    d. Internal Corners: Field-butted square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
    e. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Granite Thresholds: ASTM C 615/C 615M, with honed finish.

1. Description: Uniform, fine -grained, black stone without veining.
2. Description: Match Architect's sample.

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.
1. Nominal Thickness: 0.030 inch.
2. Nominal Thickness: 0.040 inch.

C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester.
1. Nominal Thickness: 0.025 inch.

2. Nominal Thickness: 0.040 inch.

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.

E. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with fabric reinforcement facing; 0.040-inch nominal thickness.

F. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

G. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

H. Latex-Portland Cement Waterproof Mortar: Flexible, waterproof mortar consisting of cement-based mix and latex additive.

I. Waterproofing and Tile-Setting Adhesive: One-part, fluid-applied product, intended for use as both waterproofing and tile-setting adhesive in a two-step process.

2.6 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.

C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester; 0.040-inch nominal thickness.

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.

E. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.

F. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; 0.040-inch nominal thickness.

G. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.

H. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

I. Latex-Portland Cement Crack-Resistant Mortar: Flexible mortar consisting of cement-based mix and latex additive.

J. Crack Isolation Membrane and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both a crack isolation membrane and tile-setting adhesive in a two-step process.

2.7 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: Asphalt felt, ASTM D 226/D 226M, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.
3. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C 847.

    a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
    b. Base Metal and Finish for Exterior Applications: Zinc-coated (galvanized) steel sheet.
    c. Configuration over Studs and Furring: Flat.
    d. Configuration over Solid Surfaces: Self-furring.
    e. Weight: 3.4 lb/sq. yd..

4. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

B. Dry-Set Portland Cement Mortar (Thinset): ANSI A118.1.

1. For wall applications, provide mortar that complies with requirements for non-sagging mortar in addition to the other requirements in ANSI A118.1.

C. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
3. For wall applications, provide mortar that complies with requirements for non-sagging mortar in addition to the other requirements in ANSI A118.4.

D. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.

E. EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar (Thinset): ANSI A118.11.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with [acrylic resin] [or] [styrene-butadiene-rubber] liquid-latex additive at Project site.

F. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

G. Organic Adhesive: ANSI A136.1, Type I.

2.8 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

C. High-Performance Tile Grout: ANSI A118.7.

1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
2. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

D. Water-Cleanable Epoxy Grout: ANSI A118.3.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

E. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils thick.

C. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.10 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Exterior tile floors.
    b. Tile floors in wet areas.
    c. Tile swimming pool decks.

d. Tile floors in laundries.
e. Tile floors consisting of tiles 8 by 8 inches or larger.
f. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: 1/8 inch.
2. Quarry Tile: 1/4 inch
3. Pressed Floor Tile: 1/4 inch.
4. Glazed Wall Tile: 1/8 inch.
5. Porcelain Tile: 1/4 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thinset).
2. Do not extend cleavage membrane, waterproofing, or crack isolation membrane under thresholds set in dry-set portland cement or latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane, waterproofing or crack isolation membrane with elastomeric sealant.

K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

L. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE BACKING PANEL INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.7 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.8 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION

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SECTION 09670

EPOXY FLOOR COATING

PART 1 - G E N E R A L

1.1 SUBMITTALS

A. Submit Material Safety Data Sheets, product data (including printed statement of VOC content) and manufacturer's standard color samples.

PART 2 - P R O D U C T S

2.1 MANUFACTURER/MATERIAL

A. "Aquapon WB" by Pittsburg Paints, "Tru-Glaze WB4406" by DeVoe/ICI, "Elasto-Grip FC" by Tnemec; manufacturer's standard color as selected by Architect/Engineer.

PART 3 - E X E C U T I O N

3.1 SURFACE PREPARATION

A. Examine all surfaces to which coating system is to be applied and notify the Contractor in writing of any conditions detrimental to the performance of this work. Do not proceed until unsatisfactory conditions have been corrected and are acceptable to the applicator.

B. Surfaces to be coated shall be free from oil, grease and foreign matter.

C. Etch concrete surfaces with muriatic acid and rinse with clear water. Mix 1 gallon acid and 2 gallons water per 150 square feet of floor space and apply.

3.2 APPLICATION

A. Conform with manufacturer's printed directions.

B. Protect work of other trades against damage by the work. Correct damage by cleaning, repairing or replacing and repainting as directed by the Architect/Engineer. Leave all work in undamaged condition.

C. Surfaces to receive coating shall be dry.

D. Cut coating to clean lines at intersections.

E. Apply primer or first coat in accordance with manufacturer's directions.

F. Apply second and third coats.

G. No traffic shall be allowed on surfaces until 48 hours after final coat has been applied.

END OF SECTION

SECTION 09900

PAINTS AND COATINGS

PART 1 – G E N E R A L

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints and other coatings.

C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished, unless otherwise indicated, including the following:

1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.

2. Concrete.
3. Cement board.
4. Concrete masonry units (CMUs).
5. Steel and iron.
6. Galvanized metal.
7. Aluminum (not anodized or otherwise coated).
8. Wood.
9. Gypsum board.
10. Portlant Cement Plaster (Stucco).

D. Do Not Paint or Finish the Following Items:
1. Items fully factory-finished unless specifically so 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. Floors, unless specifically so indicated.
6. Glass.
7. Concealed pipes, ducts, and conduits.

1.2 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

B. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

F. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

H. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 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; 2012.

C. GreenSeal GS-11 - Paints; 2013.

1.4 SUBMITTALS

A. See Section 01300 -Submittals, for submittal procedures.

B. Product Data: Provide complete list of all 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.
   4. Manufacturer's installation instructions.
   5. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

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 coated 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 Coatings: 1 gallon of each color; store where directed.
   2. Label each container with color in addition to the manufacturer's label.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.6 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 and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.7 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.8 WARRANTY

A. Warrant paint and coating for 1 year from date of substantial completion against becoming unserviceable or objectionable in appearance as a result of being defective or nonconforming. Without limiting this warranty scope, the work shall be warranted not to:
   1. Noticeably discolor, yellow, streak, bloom, bleach or darken.
   2. Change sheen with excessive speed or irregularity.
   3. Peel, blister, crack or alligator.
   4. Release from substrate or intermediate coats.
   5. Chalk or dust excessively.
   6. Stay tacky or become tacky.
   7. Mildew.

PART 2 – P R O D U C T S

2.1 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.

B. Provide all paint and coating products from the same manufacturer to the greatest extent possible.

C. Paints:
   1. Behr Process Corporation: www.behr.com.
   2. Diamond Vogel Paints: www.diamondvogel.com.
   3. Duron, Inc: www.duron.com.
   4. Glidden Professional, a product of PPG Architectural Coatings: www.gliddenprofessional.com.
   5. Benjamin Moore & Co: www.benjaminmoore.com.
   6. PPG Architectural Finishes, Inc: www.ppgaf.com.
   7. Pratt & Lambert Paints: www.prattandlambert.com.
   8. Sherwin-Williams Company: www.sherwin-williams.com.

D. Primer Sealers: Same manufacturer as top coats.

E. Block Fillers: Same manufacturer as top coats.

2.2 PAINTS AND COATINGS – GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
   2. Provide paints and coatings 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.
   3. 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.
   4. 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.
   5. Supply each coating material in quantity required to complete entire project's work from a single production run.
   6. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
   1. Gypsum Board: Interior Latex Primer Sealer; MPI #50.
   2. Concrete Masonry: Interior/Exterior Latex Block Filler; MPI #4.
   3. Steel, Uncoated: Anti-Corrosive Alkyd Primer for Metal; MPI #79.
   4. Steel, Uncoated: Interior Rust-Inhibitive Water Based Primer; MPI #107.
   5. Steel -- Shop Primer: Interior/Exterior Quick Dry Alkyd Primer for Metal; MPI #76.
   6. Galvanized Steel: Interior Water Based Galvanized Primer; MPI #134.
   7. Galvanized Steel: Cementitious primer.
   8. Products:
      a. Behr Premium Plus Interior All-In-One Primer and Sealer [No. 75].
      b. Behr Premium Plus Interior Drywall Primer and Sealer [No. 73].
      c. Behr Premium Plus Exterior Multi-Surface Primer and Sealer [No. 436]. (MPI #3, 107, 134)
      d. Behr Concrete and Masonry Bonding Primer [No. 880].
      e. Kilz Pro-X p50 Block Filler Primer.

C. Volatile Organic Compound (VOC) Content:
   1. Provide coatings 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.

D. Flammability: Comply with applicable code for surface burning characteristics.

E. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

2.3 PAINT SYSTEMS – EXTERIOR

A. Paint E-OP - All Exterior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including primed metal.
   1. Preparation as specified by manufacturer.
   2. Two top coats and one coat primer recommended by manufacturer.

3. Top Coat Product(s):
    a. Behr Marquee Exterior Flat [No. 4450]. (MPI #10)
    b. Behr Marquee Exterior Satin Enamel [No. 9450]. (MPI #15)
    c. Behr Marquee Exterior Semi-Gloss Enamel [No. 5450]. (MPI #11)
    d. Behr Premium Exterior Multi-Surface Flat Paint [No. 4100].
    e. Behr Premium Plus Exterior Flat [No. 4050]. (MPI #10)
    f. Behr Premium Plus Exterior Satin Enamel [No. 9050]. (MPI #15)
    g. Behr Premium Plus Exterior Semi-Gloss Enamel [No. 5050]. (MPI #11)
    h. Behr Premium Plus Interior/Exterior Hi-Gloss Enamel [No. 8050]. (MPI #119)
    i. Behr Premium Elastomeric Masonry, Stucco and Brick Paint [No. 68]. (MPI #113)
    j. Behr Premium Exterior High Build Coating [No. 4700].
    k. Behr Premium Concrete and Masonry Waterproofer [No. 870].
    l. Behr Interior/Exterior Direct-To-Metal Paint Semi-Gloss [No. 3200]. (MPI #163)
    m. Kilz Pro-X Exterior Flat PX610. (MPI #10)
    n. Kilz Pro-X Exterior Flat PX613.
4. Primer(s): As recommended by manufacturer of top coats.

B. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
1. One coat of alkyd primer.
2. Gloss: Two coats of alkyd enamel.
3. Semi-gloss: Two coats of alkyd enamel.

C. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
1. One coat galvanize primer.
2. Gloss: Two coats of alkyd enamel.
3. Semi-gloss: Two coats of alkyd enamel.

2.4 PAINT SYSTEMS – INTERIOR

A. Paint I-OP - All Interior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete masonry, uncoated steel, shop primed steel, and galvanized steel.
1. Two top coats and one coat primer.
2. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
3. Top Coat Product(s):
    a. Behr Marquee Interior Semi-Gloss Enamel [No. 3450]. (MPI #54)
    b. Behr Premium Plus Interior Semi-Gloss Enamel [No. 3050]. (MPI #54)
    c. Sherwin-Williams Pre-Catalyzed Waterbased Epoxy. (MPI #139, 141)
    d. Sherwin-Williams Harmony Interior Acrylic Latex. (MPI #44, 53, 54, 143, 144)
4. Primer(s): As recommended by manufacturer of top coats.

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
1. Medium duty applications include doors and door frames.
2. Two top coats and one coat primer.
3. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
4. Top Coat Product(s):
    a. Behr Alkyd Semi-Gloss Enamel [No. 3900].
    b. Sherwin-Williams Waterbased Catalyzed Epoxy.
    c. Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy. (MPI #139, 141)
    d. Sherwin-Williams Pro Industrial Acrylic Coating. (MPI #153, 154)
    e. Sherwin-Williams ProMar 200 Waterbased Acrylic-Alkyd.
5. Primer(s): As recommended by manufacturer of top coats.

C. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.

1. Shop primer by others.
2. One top coat; white.
3. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
4. Top Coat Product(s):
   a. Sherwin-Williams Super Save-Lite Dryfall, Semi-Gloss. (MPI #89)
   b. Sherwin-Williams Waterborne Acrylic Dryfall. (MPI #118, 155, 226)

D. Paint CI-OP-3L - Concrete/Masonry, Opaque, Latex, 3 Coat:
1. One coat of block filler.
2. Semi-gloss: Two coats of latex enamel.
3. Flat: Two coats of latex enamel.

E. Paint MI-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
1. One coat of alkyd primer.
2. Gloss: Two coats of alkyd enamel.
3. Semi-gloss: Two coats of alkyd enamel.

F. Paint MgI-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
1. One coat galvanize primer.
2. Gloss: Two coats of alkyd enamel.
3. Semi-gloss: Two coats of alkyd enamel.

G. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
1. One coat of prime Coat: Primer sealer, latex, interior.
   a. S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
2. Semi-gloss: Two coats of latex enamel.
   a. S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 – E X E C U T I O N

3.1 EXAMINATION

A. Do not begin application of coatings 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 Architect 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. Gypsum Wallboard: 12 percent.

2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing coatings that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

H. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

I. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

J. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).

K. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

L. Shop-Primed Steel Surfaces to be Finish Painted: 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.

M. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. 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. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION

SECTION 09928

PROTECTIVE COATINGS FOR WASTEWATER SYSTEMS

PART 1 - G E N E R A L

1.1 SECITON INCLUDES

A. This section includes the requirements for the provision of labor, materials and equipment to prepare surfaces and to apply protective coatings to wastewater treatment plant tanks, structures, equipment, pumps, piping and valves and miscellaneous items.

B. The term "paint" as used in this section means the protective coatings specified. Other painting may be required in other sections of the specifications. All paint for concrete or metal surfaces shall be especially adapted for use around wastewater treatment plants and shall be applied in conformance with the manufacturer's published specifications.

C. All paint for final coats shall be fume resistant, compounded with pigments suitable for exposure to sewage gases, especially to hydrogen sulfide and carbon dioxide. Pigments shall be materials that do not tend to darken, discolor or fade due to the action of sewage gases. If a paint manufacturer proposes use of paint which is not designated "fume resistant" in its literature, it shall furnish full information concerning the pigments used in this paint and test data to demonstrate its color stability and chemical resistance.

1.2 REFERENCE STANDARDS

A. Work performed and materials used must comply with the requirements of the Steel Structures Painting Council's Vol. No. 1, "Good Painting Practices," and Vol. 2, "Systems and Specifications," and these technical specifications. Where a conflict exists between these technical specifications and the Steel Structures Painting Council's specifications, these technical specifications govern.

B. ASTM (American Society for Testing and Materials).

1. ASTM D 520 – Standard Specification for Zinc Dust Pigment.
2. ASTM D 4417 – Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
3. ASTM E 337 – Standard Practice Test Method for Measuring Humidity with a Psychrometer.
4. ASTM D2200 – Standard Methods of Evaluating Degree of Rusting on Painted Surfaces.

C. ANSI (American National Standards Institute).

1. ANSI/ASC 29.4 – Exhaust Systems, Abrasive Blasting Operations – Ventilation and Safe Practice.
2. ANSI/NSF Std. 61 – Drinking Water Components.

D. AWWA (American Water Works Association).

1. AWWA D 102 – Coating Steel Water Storage Tanks.

E. Consumer Product Safety Act, Part 1303.

F. Mil Spec (Military Specifications)

1. Mil Spec DOD-P-23236 – Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast, Class 2

G. NACE International.

1. NACE Publication TPC2 – Coatings and Linings for Immersion Service: Chapter 1 Safety, Chapter Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection.
2. NACE Standard RP0178 – Standard Recommended Practice – Fabrication Details, Surface Finish Requirements and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service.
3. NACE Standard RP0188 – Standard Recommended Practice – Discontinuity (Holiday) Testing of Protective Coatings.
4. NACE Standard RP0287 – Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape.
5. NACE Standard RP0288 – Standard Recommended Practice, Inspection of Linings on Steel and Concrete.

H. OSHA (Occupational Safety & Health Administration).

1. 1915.35 Standards – 29 CFR – Painting.

I. SSPC (Society for Protective Coatings).

1. SSPC-SP1– Solvent Cleaning.
2. SSPC-SP2 – Hand Tool Cleaning.
3. SSPC-SP3 – Power Tool Cleaning.
4. SSPC-SP11– Power Tool Cleaning to Bare Metal.
5. SSPC-PA-1– Shop, Field and Maintenance Painting.
6. SSPC-PA-2 – Measurement of Dry Film Thickness with Magnetic Gages.
7. SSPC-PA-3 – Guide to Safety in Paint Application.
8. SSPC-Guide 12 – Guide for Illumination of Industrial Painting Project.
9. SSPC-VIS 1-89 – Pictorial Surface Preparation Standards for Painting Steel Surfaces.
10. SSPC Paint Spec 36 – Two Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based.
11. SSPC-QP 1 – Standard Procedure for Evaluating Qualifications of Painting Contractors
12. SSPC-QP 2 - Standard Procedure for Evaluating Qualifications of Painting Contractors to Remove Hazardous Paint

J. SSPC/NACE Joint Standards.

1. SSPC-SP5/NACE 1 – White Metal Blast Cleaning.
2. SSPC-SP6/NACE 3 – Commercial Blast Cleaning.
3. SSPC-SP7/NACE 4 – Brush-Off Blast Cleaning.
4. SSPC-SP10/NACE 2 – Near-White Metal Blast Cleaning.

1.3 SUBSTITUTIONS

A. Wherever a product is designated by trade name with provision for and approved substitution, the products specified must be used unless a written request for substitution is submitted to the Engineer at least 7 days before the receipt of bids. The request for substitution must include all Product Data as described in paragraph 1.4C of this section and be in accordance with Section 01630 – Product Options and Substitutions.

B. To establish equality, furnish satisfactory documentation form the manufacturer of the proposed substitute product that the material meets the indicated requirement and is equivalent to or better in the following properties:

1. Resistance to abrasion and physical damage
2. Resistance to chemical attack.
3. Life expectancy.
4. Ability to recoat in the future.
5. Solids content by volume.
6. Dry film thickness per coat.
7. Compatibility with other coatings.
8. Suitability for the intended service.
9. Temperature limitations in service and during application.
10. Type and quality of recommended undercoats and topcoats.
11. Ease of application.
12. Ease of repairing damaged areas.
13. Stability of colors.
14. VOC content expressed in grams per liter.

C. Consideration will be given only to those products which have been used in wastewater treatment plant service for at least 5 years. The request for substitution must include a list of at least 10 applications in the Gulf Coast area where the product has been in continuous use for at least 5 years. Furnish the Owner's name, the Owner's Representative's name and the name of product used.

1.4 SUBMITTALS

A. Product Data and Shop Drawings. Make Submittals in accordance with Section 01330 – Submittal Procedures

B. Certificates. Before beginning work, submit to the Engineer a certificate from the paint supplier stating that sufficient paint has been purchased to provide the coatings specified in this section. List on the certificate the quantities and types of paint purchased. In addition, submit to the Engineer a certificate from the blast cleaning abrasive supplier stating that sufficient abrasive has been purchased for the surface preparation specified in this section; list on the certificate the quantities and gradation purchased.

C. Product Data. Complete data on each type and kind of paint and primer shall be submitted to the Engineer for review. Favorable review shall be obtained from the Engineer before the paint is delivered to the job site. This procedure must be followed whether or not the paint that the Contractor proposes to use is named in the specifications. Submittal data shall show where and for what uses each paint product is to be used, with cross reference made to paragraphs of the specifications or the coating schedule. For each paint/coating system to be used, submit the following data:
   1. Paint manufacturer's Product Data Sheet for each product proposed, including statement on the suitability of the material for the intended use.
   2. Technical and performance information that demonstrates compliance with the system performance and material requirements.
   3. Paint Manufacturer's instructions and recommendations on surface preparation, application, and curing as described in section D below.
   4. Colors available for each product, where applicable.
   5. Compatibility of shop and field applied coatings, where applicable.
   6. Material Safety Data Sheets for each product used.
   7. VOC of each paint or coating proposed, stated in grams per litre.

D. Manufacturer's Instructions. The manufacturer's published instructions, for use as a guide in specifying and applying the manufacturer's proposed paint, shall be submitted to the Engineer. Paint shall not be delivered to the jobsite before review of the manufacturer's instructions by the Engineer. A manufacturer's paint will not be considered for use unless that manufacturer's published instructions meet the following requirements:

1. The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this contract.
2. All limitations, precautions and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended, that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall include, but not be limited to, the following:
    a. Surface preparation.
    b. Methods of application.
    c. Number of coats.
    d. Thickness of each coat.
    e. Total thickness.
    f. Drying time of each coat, including primer.
    g. Drying time of final coat before placing in service.
    h. Time allowed between coats.
    i. Primer required to be used.
    j. Primers not permitted.
    k. Use of a primer.
    l. Compatible topcoats.
    m. Thinner and use of thinner.
    n. Weather limitations during and after application (temperature, humidity, wind velocity.).
    o. Protection from sun.
    p. Physical properties of paint, including solids content and ingredient analysis.
    q. Cathodic disbonding limitations, if any.
    r. Equipment settings (air cap, fluid tip, equipment pressure settings, etc.).

E. Samples
1. Submit color samples of paint, finishes, and other coating materials on 8 1/2 inch by 11-inch sheet of metal or heavy cardstock. Have each sheet completely coated over its entire surface with one protective coating material, type, and color.
2. Provide two sets of color samples to match each color selected by the City from the manufacture's standard color sheets. If custom-mixed colors are indicated, prepare color samples using color formulations prepared to match the color samples furnished by the City.

1.5 DELIVERY AND STORAGE

A. Delivery. Have paint delivered to the job site in original unopened containers.

B. Storage. Store materials in an approved location. Keep the storage area clean and repair any damage done. Remove oily rags, waste, or other fire hazards from buildings each night; take adequate precautions to avoid damage by fire. Place cloths and cotton waste which might constitute a fire hazard in metal containers or destroy at the end of each work day. Storage facilities shall meet City of Houston Fire Code Requirements.

1.6 MAINTENANCE MATERIAL

A. At the end of the project, the Contractor shall turn over to the Owner a gallon can of each type and color of paint, primer, thinner, or other coatings used in the field painting. The material shall be delivered in unopened labeled cans, just as it comes from the factory. If the manufacturer does not package the material in gallon cans, and in the case of special colors, the materials shall be delivered in new gallon containers, properly closed with typed labels indicating brand, type, color, etc. Where multiple component materials are used, the Contractor shall supply an unopened kit of the necessary materials in the manufacturer's smallest standard packaging size (i.e., a 2-component epoxy with a 1:1 mix ratio would require a 1-gallon

can of resin and a 1-gallon can of curing agent). The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three bound copies. A typewritten inventory list shall be furnished at the time of delivery.

1.7 QUALIFICATIONS

A. Submit five (5) references which show that the painting Contractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the painting Contractor provided the protective coating. As an alternative, submit proof of certification in accordance with SSPC-QP 1.

B. For any project which involves removal or repair of lead-based paints, submit proof of certification in accordance with SSPC-QP 2.

PART 2 - P R O D U C T S

2.1 COATING CRITERIA

A. Compatibility: In any coating system, use only compatible materials from a single manufacturer. Give particular attention to compatibility of primers, intermediate coats and finish coats. If necessary, apply a barrier coat or tie coat between existing prime coat and subsequent field coats to ensure compatibility. Application of coatings from more than one manufacturer will not be allowed.

2.2 ACCEPTABLE MANUFACTURERS

A. The following are acceptable manufacturers for coating systems, as applicable:
   1. Raven Lining Systems, Inc.
   2. Sauereisen.
   3. Sherwin Williams.
   4. Carboline.
   5. Tnemec.
   6. PPG Amercoat.

2.3 COLOR SCHEDULE

A. All protective coatings shall be based on the color code schedule found in 3.09F of this Section. Substitute colors shall be approved by the Engineer.

2.4 TEST EQUIPMENT

The following pieces of equipment will be furnished in good working order by the Contractor and may be used by Owner's Inspector to determine film thickness and presence of flaws. All equipment shall be capable of verifying the work as specified.

A. Dry film gauge.

B. High-voltage flaw detector (Holiday Detector).

C. Surface profile replica tape and micrometer.

D. Sling psychrometer.

E. Wet film gauge.

PART 3 - E X E C U T I O N

3.1 WORK CONDITIONS

A. Weather. No coating or painting shall be applied: 1) when the surrounding air temperature or the temperature of the surface to be coated or painted is below 50°F (10.0°C); 2) to wet or damp surfaces or in rain, snow, fog or mist; 3) when the temperature is less than 5°F (2.78°C) above the dew point; 4) when it is expected the air temperature will drop below 50°F (10.0°C) or less than 5°F (2.78°C) above the dew point within 8 hours after application of coating or paint. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric tables. If preceding conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions. The weather conditions shall be adhered to unless otherwise specified under individual coating systems.

B. Surface. If surfaces to be painted cannot be put in proper condition for painting by customary cleaning and abrasive operations, notify the Engineer in writing or assume the responsibility for and rectify any unsatisfactory finish resulting from application to an unsatisfactory surface. Do not apply paint to a wet or damp surface.

C. Equipment. The Contractor's coating and painting equipment shall be designed for application of the materials specified and shall be maintained in good working order comparable to that described in printed instructions of the coating manufacturer. Clean equipment thoroughly before and after use with the appropriate cleaning solution indicated by the coating manufacturer. All gauges and controls on spray equipment shall be in proper working order at all times and the gauges must be operational and readable.

D. Warnings. Display caution signs in necessary areas advising of spray painting and warning against open flames.

3.2 SURFACE PREPARATION

A. Solvent Cleaning. Remove oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action, in accordance with Steel Structures Painting Council Surface Protection Specifications (SSPC) SP-1.

B. Grinding. Remove weld splatter and rough edges and grind rough welds so that all surfaces are in proper condition, in the opinion of the Engineer, to receive the specified coating.

C. Abrasive Blast Cleaning.

1. Use a source that provides compressed air, free of detrimental amounts of water and oil. The compressor shall, as a minimum, be capable of delivering a pressure at the blast nozzle of at least 90 psig; the blast nozzle shall be of the venturi type.
2. Abrasively clean only those areas that can be primed the same day or before any rust starts to form, whichever occurs first. Areas which are not painted the same day must be cleaned again on the day the prime coat is applied. Remove the abrasive material from surface by brush or industrial vacuum.

D. Power Tool Cleaning. Subject to review by the Engineer, any above metalwork in which SP-6 or SP-10 cannot be accomplished shall be cleaned in accordance with SSPC SP-3, Power Tool Cleaning, removing loose mill scale, loose rust, loose paint and other foreign matter.

E. Shop Priming. Where metalwork, equipment, valves and the like are shop primed, the primer used must be compatible with the coating system to be applied in the field. All information shall be furnished regarding the shop prime coat and, if not compatible with succeeding coats, in the opinion of the Engineer, the shop prime coat shall be removed by abrasive blast cleaning or as otherwise directed by the Engineer.

F. Unknown or Noncompatible Materials. Items coated with an unknown paint system, or a primer or system which is not compatible with the specified system, shall be blast cleaned and recoated with the specified coating system at the job site. When abrasive blast cleaning is not feasible, the Contractor shall notify the Engineer and request permission to apply a barrier coat over the unknown or noncompatible material. The proposed barrier coat must be recommended in writing by the paint system manufacturer and is subject to review by the Engineer. Following application of the barrier coat, if permitted, the specified coating system shall be applied. Minimum dry film thickness shall be increased an amount equal to the barrier coat and unknown or noncompatible coats.

3.3 COATING APPLICATION

A. Manufacturer's Representative. The coating manufacturer will be responsible, through an authorized representative, to provide technical assistance to the paint contractor as needed.

B. Workmen. Employ workmen skilled in structural steel, piping, and mechanical equipment painting.

C. Materials.

1. Coating materials, abrasive, and equipment used in painting and abrasive cleaning are subject to inspection at any time by the Engineer or his representative.
2. Remove blasting material and dust from the surface to be painted before paint application is begun.

D. General Application Requirements.

1. Prepare all surfaces to receive materials as required herein or as required by the coatings manufacturer. Clean surfaces to remove all foreign matter. Roughen surface as recommended by the coating manufacturer for proper adhesion of coating to the substrate.
2. Items to be attached to similar or dissimilar materials shall be back coated as specified for the exposed surfaces of those items. Mask or protect finished surfaces in area being coated. Remove, replace, and protect finished items adjacent to surfaces to be coated. Reinstall items when painting is complete.
3. Mix and apply materials in accordance with the manufacturer's printed instructions. Allow each succeeding coat to dry in accordance with manufacturer's printed instructions.
4. Include painting of engaged and free standing columns or similar items when painting walls.
5. Do not paint code required labels, (Underwriters Laboratories, Inc., Factory Mutual, or the like) or any equipment identification, performance ratings, name, or nomenclature plates. Remove any paint inadvertently applied to such items.
6. Protect adjacent walls, floors, and ceilings against splash or overspray. Remove materials from surfaces not designated to receive such materials.
7. Remove waste rags and coating debris on a daily basis. Keep storage spaces and work areas neat and clean.

E. Paint Coating Methods.

1. Double-lap all welds. Apply prime coat by brush to all weld areas; then apply prime coat to entire surface, including weld areas, by spray, roller or method selected.
2. Coat areas with a uniform film, free of sags, runs, or brushmarks. Where multiple coats of paint are specified, apply each coat in a different color which complements the following coat and is different than the preceding coat. Each coat must be free of shadows and uniform in appearance.
3. Except where otherwise specified, thin paint only as necessary for workability of coating material in accordance with manufacturer's printed instructions. Use only an appropriate thinner as recommended by the paint manufacturer.
4. When paint is being applied to interior of wet well or any other closed areas, provide adequate ventilation.
5. Comply with recommendations of the paint manufacturer in regard to drying time for each coat, technique of spray application, ventilation, paint thinning, and safety precautions. The Contractor must fully inform all members of his field crew of these recommendations.

6. Where inspection shows that the specified thickness is not developed, apply additional coats in accordance with the manufacturer's surface preparation and cure schedule requirements to produce the required film thickness.
7. Repair and recoat improper applications as recommended by the manufacturer or as required by the Engineer.
8. Factory finished items shall be protected against damage during transit, storage and erection. Damaged areas must be refinished as the original so that at the end of the project the finish on all items will be in perfect shape. The following items shall receive final finish at the factory, colors to be reviewed by the Engineer.
   a. Electrical panels (to be factory painted ANSI No. 61 gray).
   b. Light fixtures.
   c. Pressure gauges.
   d. Instrumentation.
   e. Similar equipment with standard factory finish, subject to Engineer's review.
9. The following items shall not be painted unless otherwise specified:
   a. Aluminum, brass, bronze, chrome, copper or stainless steel.
   b. Nameplates or serial numbers.
   c. Grease fittings.
   d. Valve operator stems.
   e. Buried or encased piping or conduit.
   f. Concrete floors and slabs not exposed to wastewater.
   g. Glass.

F. Cleaning. Upon completion of the work, remove all staging and scaffolding. Dispose of all used sand, containers and rubbish in a suitable manner. Remove paint spots, oil or stains on adjacent surfaces. Leave the entire job clean and acceptable.

3.4 COATING SCHEDULE

A. Coat each item listed below using the coating specified.

Item to be Coated	**Coating System**
Exposed structural steel for bridge cranes, monorails cranes and platform supports	Polyurethane Three-Coat System, Premium Epoxy Coating System, or Fusion Bonded Epoxy Coating
Equipment such as pumps, blowers, motor housings, etc.	Polyurethane Three-Coat System or Premium Epoxy Coating System
Above ground and non-submerged piping and valves	Polyurethane Three-Coat System, Premium Epoxy Coating System, or Fusion Bonded Epoxy Coating
Submerged structural steel and piping	Polyurethane Three-Coat System, Coal Tar Epoxy, or Fusion Bonded Epoxy Coating
Cast-in-place Concrete Structures, Precast Concrete Manholes, and Cast-in-place Concrete Manholes	Raven 405, Raven 405 UFS, Plasite 4500 S, or SewerGard No. 210S

3.5 COATING SYSTEMS

A. Raven 405 or Carboline Plasite® 4500 S System.

1. Surface Preparation.
   a. Protection. Vehicles, equipment, structures or other nearby surfaces not to be coated shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.
   b. New Concrete.

1) Concrete should be floated free of sharp edges, ridges or depressions. All structural cracks shall be repaired, voids filled, and slopes reestablished. New concrete must be allowed to cure for a minimum of 28 days prior to applying a protective lining system. This usually is sufficient time to allow for shrinkage and for new concrete pours to dissipate a sufficient amount of moisture.

2) Moisture Testing. New concrete should be installed over a moisture barrier to eliminate moisture transmission through the concrete floor. Prior to the application of materials, the moisture content must be determined using a suitable Moisture Detection System such as that manufactured by Sealflex Industries, 2925 College Ave., #B4, Costa Mesa, CA (714-708-0850). An average value exceeding 3.0 lbs/1000 ft^2/24-hour period is unacceptable and will require additional cure time, the application of a surface penetrating vapor barrier or other corrective measures. Retest after taking corrective measure to ensure an average value below 3.0 pounds.

3) All concrete structures to receive lining system must be properly designed and capable of withstanding imposed loads. Surfaces must be dry, firm, free of laitance, form release agents, standing water and have attained 3000 psi compressive strength or be structurally sound as determined by Owner's Representative. The cleaning of contaminants may be attained by a chemical cleaner such as CHLOR*RID with NO rinse.

4) Abrasive blast to expose fine aggregate, using a shotblasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #5 comparator, minimum. (Note: ICRI = International Concrete Repair Institute.)

c. Old Concrete.

1) All concrete structures to receive lining system must be capable of withstanding imposed loads. All oil, grease and chemical contaminants must be removed from the surface of concrete by chemical cleaning. The cleaning of contaminants may be attained by a chemical cleaner such as CHLOR*RID with NO rinse. Surfaces must be firm, free of standing water, laitance, form release agents, and be structurally sound as determined by Owner's Representative.

2) Abrasive blast to expose fine aggregate. Use a shotblasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #5 comparator, minimum. (Note: ICRI = International Concrete Repair Institute.)

2. Application.

a. 100% solids, solvent-free epoxy grout that can be troweled or sprayed and specifically formulated for optimum epoxy topcoating compatibility. The epoxy grout manufacturer shall provide instructions for epoxy topcoating procedures.

1) Cementitious repair materials shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar.

2) Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the Owner's Representative and protective coating applicator. Repair materials must be compatible with the specified epoxy coating and shall be applied and cured in accordance with the manufacturer's recommendations.

3) For lift station applications, apply coating on all wall, floor and ceiling surfaces. For all other applications, apply coating from top of structure to one (1)-foot below minimum water surface elevation.

b. Raven Lining Systems' Raven 405 and Carboline's Plasite® 4500 S coating systems

1) Raven Lining Systems' Raven 405 coating system - a 100% solids, solvent-free two-component epoxy resin system thixotropic in nature and filled with select fillers to minimize permeability and provide sag resistance

2) Carboline's Plasite® 4500 S coating system - a 100% solids, flake-filled, two-component epoxy resin system

3) Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating.

4) The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.

5) Installation. Specified surfaces shall be coated by spray application of Raven 405 or Carboline Plasite® 4500 S moisture tolerant, solvent-free, 100% solids, epoxy protective coating. Spray application shall be to the following wet film thickness: 100 mils minimum thickness

c. Contractor Prequalification.

1) Raven Lining Systems' or Carboline's certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.

2) Certification by Raven Lining Systems or Carboline that the equipment to be used for applying the products has been approved and Applicator personnel have been trained and certified for proper use of the equipment

3) Two (2) years experience and five (5) recent references of projects of similar size and scope and Applicator must provide references indicating successful application on underground concrete or masonary substrates of a minimum 5,000 sf of Raven Lining Systems' 100% solids, high-build solvent-free epoxy coating by heated, plural component spray application or Carboline's 100% solids, flake-filled epoxy coating by plural component spray application.

B. SewerGard No. 210S System.

1. Surface Preparation.

a. Protection. Vehicles, equipment, structures or other nearby surfaces not to be coated shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.

b. New Concrete.

1) Concrete should be floated free of sharp edges, ridges or depressions. All structural cracks shall be repaired, voids filled and slopes reestablished. New concrete must be allowed to cure for a minimum of 28 days prior to applying a protective lining system. This usually is sufficient time to allow for shrinkage and for new concrete pours to dissipate a sufficient amount of moisture.

2) Moisture Testing. New concrete should be installed over a moisture barrier to eliminate moisture transmission through the concrete floor. Prior to the application of materials, the moisture content must be determined using a suitable Moisture Detection System such as that manufactured by Sealflex Industries, 2925 College Ave., #B4, Costa Mesa, CA (714-708-0850). An average value exceeding 3.0 lbs/1000 ft^2/24-hour period is unacceptable and will require additional cure time, the application of a surface penetrating vapor barrier or other corrective measures. Retest after taking corrective measure to ensure an average value below 3.0 pounds.

3) All concrete structures to receive lining system must be properly designed and capable of withstanding imposed loads. Surfaces must be dry, firm, free of laitance, form release agents, standing water and have attained 3000 psi compressive strength or be structurally sound as determined by Owner's Representative. The cleaning of contaminants may be attained by a chemical cleaner such as CHLOR*RID with NO rinse.

4) Abrasive blast to expose fine aggregate, using a shotblasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #3-5 comparators. (Note: ICRI = International Concrete Repair Institute.)

c. Old Concrete.

1) All concrete structures to receive lining system must be capable of withstanding imposed loads. All oil, grease and chemical contaminants must be removed from the surface of concrete by chemical cleaning. The cleaning of contaminants may be attained by a

chemical cleaner such as CHLOR*RID with NO rinse. Surfaces must be firm, free of standing water, laitance, form release agents, and be structurally sound as determined by Owner's Representative.

2) Abrasive blast to expose fine aggregate. Use a shotblasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #3-5 comparators. (Note: ICRI = International Concrete Repair Institute.)

2. Application.

a. Epoxy Filler Compound No. 209. Used for filling bug holes, static cracks and joints and for general concrete patching.

1) Mixing. Add contents of hardener to liquid and mix with a slow-speed paddle or "Jiffy" mixer for 1 minute until thoroughly blended. Add the powder gradually while mixing with same slow-speed mixer to obtain a uniform consistency. Mix only complete batches. Material which has begun to set must be discarded. Do not try to retemper the material.

2) Installation. To maximize working time, spread mixed No. 209 onto a plasterer's hawk upon completion of the mixing. Apply No. 209 to concrete with a smooth plasterer's rubber float. After application, excess material must be removed by using the edge of the float or squeegee.

3) For lift station applications, apply coating on all wall, floor and ceiling surfaces. For all other applications, apply coating from top of structure to one (1)-foot below minimum water surface elevation.

b. SewerGard No. 210S. Corrosion-resistant, spray-applied epoxy lining.

1) No. 210S is a two-component product, packaged in premeasured containers consisting of liquid and hardener.

2) Remix contents of liquid component for a minimum of 2 minutes with a "Jiffy" type mixer.

3) Remix contents of the hardener by shaking; then add to liquid and mix for a minimum of 3 minutes until thoroughly blended.

4) Mix only complete batches. Material which has begun to set must be discarded. Do not try to retemper the material.

5) Installation. SewerGard No. 210S is applied by spray method to a thickness of 60 mils. Theoretical coverage is 90.5 square feet per unit at 60 mil thickness. Coverage is theoretical and will vary depending upon surface conditions, porosity, application techniques and project specifics.

c. Contractor Prequalification.

1) Sauereisen No. 210S System Applicators. Each applicator who is to apply the No. 210S system must be tested prior to proceeding with the installation of materials, in order to determine qualification and skill. This prequalification test will be conducted to ensure that the materials will be applied in a manner that will produce a strong, uniform, well-bonded, holiday-free lining.

2) No. F-120/209. A 3′ x 5′ concrete panel will be used for each applicator. The surface of the concrete must be properly prepared for the applicator as outlined in this specification. The applicator must show competency in applying both products per the specification in regards to mixing, application techniques, cleanup and safety precautions.

3) The No. 210S must be applied in one coat to a minimum 60-mil thickness and must be uniform in appearance and thickness. SewerGlaze must be applied in one coat to a minimum thickness of 8 mils and must be uniform in appearance and thickness. The applicator must show competency in spray applying epoxy systems, including but not limited to mixing, application techniques, cleanup and safety precautions.

C. Polyurethane Three-Coat System.

1. Surface Preparation.
   a. Protection. Vehicles, equipment, structures, or other nearby surfaces not to be coated, shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.
   b. Initial Cleaning. If necessary, surfaces shall be decontaminated by high-pressure water blasting, steam cleaning, or by any other method, to remove all oils, greases, scum and surface contaminants.
   c. Abrasive Blast Cleaning for External Coating.
      1) Surfaces shall be cleaned as per SSPC Standard SP-10, "Commercial Blast Cleaning."
      2) Immersed surfaces to receive an external coating shall be abrasive blasted per SSPC Standard No. SP-10, "Near-White Blast Cleaning" with a 1-1/2 to 2 mil (37.5-50 micron) surface profile. Blast or grind irregular surfaces to same condition as flat surfaces. Sharp edges shall be ground down and rounded.
   d. Cleaning of Adjacent Areas: After abrasive blasting is completed, areas adjacent to the work area shall be cleaned of dirt, blasting residues and other debris to prevent wind-blown contamination of the prepared substrate or freshly applied coatings.
   e. Final Cleaning Before Application of Primer: Just prior to primer application, surfaces to be coated shall be power vacuumed to remove all dust and blasting residues. Transitions into adjacent areas not to be coated shall be neatly taped off or otherwise protected. Steel surfaces must be absolutely dry and dust-free prior to and during application of the primer.
2. Three Coat Application. The total dry film thickness (DFT) after 5 days shall be 9 to 13 mils for metallic surfaces.
   a. First Coat. First coat with zinc rich epoxy or organic zinc primer @ 3 to 4mils DFT.
   b. Second Coat. Second coat with chemical resistant epoxy @ 4 to 6 mils DFT.
   c. Third Coat. Third coat with UV stable polyurethane topcoat @ 2 to 3 mils DFT.

D. 100% Solids Elastomeric Polyurethane Two Coat System.

1. Surface Preparation.
   a. Protection. Vehicles, equipment, structures, or other nearby surfaces not to be coated, shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.
   b. Decontamination. Surfaces previously exposed to salts or other chemical service shall be decontaminated by high-pressure fresh water blasting, steam cleaning, or by any method to remove all surface contaminants and eliminate or reduce subsurface contaminants to an acceptable level. If detergents are used, they shall be completely rinsed off with plenty of fresh water.
   c. Abrasive Blast Cleaning for External Coating.
      1) Surfaces shall be cleaned as per SSPC Standard SP-10, "Commercial Blast Cleaning."
      2) Immersed surfaces to receive an external coating shall be abrasive blasted per SSPC Standard No. SP-10, "Near-White Blast Cleaning" with a 1-1/2 to 2 mil (37.5-50 micron) surface profile. Blast or grind irregular surfaces to same condition as flat surfaces. Sharp edges shall be ground down and rounded.
   d. Cleaning of Adjacent Areas. After abrasive blasting is completed, areas adjacent to the work area shall be cleaned of dirt, blasting residues and other debris to prevent wind-blown contamination of the prepared substrate or freshly applied coatings.
   e. Final Cleaning Before Application of Primer. Just prior to primer application, surfaces to be coated shall be power vacuumed to remove all dust and blasting residues. Transitions into adjacent areas not to be coated shall be neatly taped off or otherwise protected. Steel surfaces must be absolutely dry and dust-free prior to and during application of the primer.
   f. Concrete surfaces to be coated that are subject to immersion conditions shall be abrasive blast cleaned per ASTM D4259, Abrading Concrete, to provide a minimum height profile of 5 to 8 mils.

Blasting must produce an even profile, free of loose aggregate, weak matrix, crusts, dusting and other contaminants.

2. Two Coat (Primerless) Application. The total dry film thickness (DFT) after the top coat has dried 5 days shall be 42 to 52 dry mils for concrete, masonry or immersed metallic surfaces.

a. First Coat. First coat with 2 component polyurethane elastomer @ 32 to 40 mils DFT.

b. Second Coat. Second coat with 2 component crosslinked UV stable topcoat @ 10 to 12 mils DFT.

E. Premium Epoxy Coating System.

1. Surface Preparation.

a. Protection. Vehicles, equipment, structures, or other nearby surfaces not to be coated, shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.

b. Initial Cleaning. If necessary, surfaces shall be decontaminated by high pressure water blasting, steam cleaning or by any other method to remove all oils, greases, scum and surface contaminants.

c. Decontamination. Surfaces previously exposed to salts or other chemical services shall be decontaminated by high pressure fresh water blasting, steam cleaning or by any method to remove all surface contaminants and eliminate or reduce subsurface contaminants to an acceptable level. If detergents are used, they shall be completely rinsed with plenty of fresh water.

d. Abrasive Blast Cleaning for External Coating.

1) Surfaces shall be cleaned as per SSPC Standard SP-10, "Commercial Blast Cleaning."

2) Immersed surfaces to receive an external coating shall be abrasive blasted per SSPC Standard No. SP-10, "Near-White Blast Cleaning" with a 1-1/2 to 2 mil (37.5-50 micron) surface profile. Blast or grind irregular surfaces to same condition as flat surfaces. Sharp edges shall be ground down and rounded.

e. Cleaning of Adjacent Areas. After abrasive blasting is completed, areas adjacent to the work area shall be cleaned of dirt, blasting residues and other debris to prevent wind-blown contamination of the prepared substrate or freshly applied coatings.

f. Final Cleaning Before Application. Just prior to application, surfaces to be coated shall be power vacuumed to remove all dust and blasting residues. Transitions into adjacent areas not to be coated shall be neatly taped off or otherwise protected. Steel surfaces must be absolutely dry and dust-free prior to and during application of the coating.

g. Concrete surfaces to be coated that are subject to immersion conditions shall be abrasive blast cleaned per ASTM D4259, Abrading Concrete, to provide a minimum height profile of 5 to 8 mils. Blasting must produce an even profile, free of loose aggregate, weak matrix, crusts, dusting and other contaminants.

2. Two Coat (Primerless) Application (to be used only on indoor applications). The total dry film thickness (DFT) after 5 days shall be 40 mils for concrete, masonry or immersed metallic surfaces.

a. First Coat First coat with flake-filled premium epoxy @ 20 mils dry film thickness.

b. Second Coat. Second coat with flake-filled premium epoxy @ 20 mils dry film thickness.

3. Three Coat Application (required for outdoor applications). The total dry film thickness (DFT) after 5 days shall be 9 to 13 mils for metallic surfaces.

a. First Coat. First coat with zinc rich epoxy or organic zinc primer @ 3 to 4 mils dry film thickness.

b. Second Coat. Second coat with chemical resistant epoxy @ 4 to 6 mils dry film thickness.

c. Third Coat. Third coat with UV stable polyurethane topcoat @ 2 to 3 mils dry film thickness.

F. Coal Tar Epoxy.

1. Product. Use a high-build, 2-component amine or polyamide-cured coal tar epoxy with a solids content of at least 68 percent by volume. Use a coating suitable for long-term immersion in wastewater or for coating of buried surfaces. Coating must conform to Mil Spec DOD-P-23236, or SSPC Paint 16. Prime

coats are for use as a shop primer only. Omit prime coat when both surface preparation and coating are performed in field.

2. Surface Preparation.
   a. Protection. Vehicles, equipment, structures, or other nearby surfaces not to be coated, shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.
   b. Initial Cleaning. If necessary, surfaces shall be decontaminated by high pressure water blasting, steam cleaning or by any other method to remove all oils, greases, scum and surface contaminants.
   c. Decontamination. Surfaces previously exposed to salts or other chemical services shall be decontaminated by high pressure fresh water blasting, steam cleaning or by any method to remove all surface contaminants and eliminate or reduce subsurface contaminants to an acceptable level. If detergents are used, they shall be completely rinsed with plenty of fresh water.
   d. Abrasive Blast Cleaning per SSPC Standard No. SP-10, "Near-White Blast Cleaning" with a 1-1/2 to 2 mil (37.5-50 micron) surface profile. Blast or grind irregular surfaces to same condition as flat surfaces. Sharp edges shall be ground down and rounded. If flash rust develops, all traces shall be removed by abrasive sweep blast before priming.
   e. Cleaning of Adjacent Areas. After abrasive blasting is completed, areas adjacent to the work area shall be cleaned of dirt, blasting residues and other debris to prevent wind-blown contamination of the prepared substrate or freshly applied coatings.
   f. Final Cleaning Before Application of Coating. Just prior to primer application, surfaces to be coated shall be power vacuumed to remove all dust and blasting residues. Transitions into adjacent areas not to be coated shall be neatly taped off or otherwise protected. Steel surfaces must be absolutely dry and dust-free prior to and during application of the primer.
3. Application. The total dry film thickness after 5 days shall be 20 mils.
   a. One Coat (Primerless). 20 mils dry film thickness.

G. Tnemec 436 Fiber-Reinforced Modified Polyamine Epoxy

1. Surface Preparation.
   a. Protection. Vehicles, equipment, structures or other nearby surfaces not to be coated shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.
   b. New Concrete.
      1) Concrete should be floated free of sharp edges, ridges or depressions. All structural cracks shall be repaired, voids filled and slopes reestablished. New concrete must be allowed to cure for a minimum of 28 days prior to applying a protective lining system. This usually is sufficient time to allow for shrinkage and for new concrete pours to dissipate a sufficient amount of moisture.
      2) Moisture Testing. New concrete should be installed over a moisture barrier to eliminate moisture transmission through the concrete floor. Prior to the application of materials, the moisture content must be determined using a suitable Moisture Detection System such as that manufactured by Sealflex Industries, 2925 College Ave., #B4, Costa Mesa, CA (714-708-0850). An average value exceeding 3.0 lbs/1000 ft^2/24-hour period is unacceptable and will require additional cure time, the application of a surface penetrating vapor barrier or other corrective measures. Retest after taking corrective measure to ensure an average value below 3.0 pounds.
      3) All concrete structures to receive lining system must be properly designed and capable of withstanding imposed loads. Surfaces must be dry, firm, free of laitance, form release agents, standing water and have attained 3000 psi compressive strength or be structurally sound as determined by Owner's Representative. The cleaning of contaminants may be attained by a chemical cleaner such as CHLOR*RID with NO rinse.
      4) Abrasive blast to expose fine aggregate, using a shotblasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore

nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #5 comparator, minimum. (Note: ICRI = International Concrete Repair Institute.)

c. Old Concrete.

1) All concrete structures to receive lining system must be capable of withstanding imposed loads. All oil, grease and chemical contaminants must be removed from the surface of concrete by chemical cleaning. The cleaning of contaminants may be attained by a chemical cleaner such as CHLOR*RID with NO rinse. Surfaces must be firm, free of standing water, laitance, form release agents, and be structurally sound as determined by Owner's Representative.

2) Abrasive blast to expose fine aggregate. Use a shotblasting machine or standard sandblasting equipment, with a safe pressure, approximately 60-70 psi at a straight bore nozzle. Surface preparation requirement is to obtain a uniform surface texture resembling an ICRI CSP #5 comparator, minimum. (Note: ICRI = International Concrete Repair Institute.)

2. Application.

a. 100% solids, solvent-free epoxy grout that can be troweled or sprayed and specifically formulated for optimum epoxy topcoating compatibility. The epoxy grout manufacturer shall provide instructions for epoxy topcoating procedures.

1) Cementitious repair materials shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar.

2) Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the Owner's Representative and protective coating applicator. Repair materials must be compatible with the specified epoxy coating and shall be applied and cured in accordance with the manufacturer's recommendations.

3) For lift station applications, apply coating on all wall, floor and ceiling surfaces. For all other applications, apply coating from top of structure to one (1)-foot below minimum water surface elevation.

b. Tnemec 436 Perma-Shield FR coating system

1) Tnemec 436 Perma-Shield FR coating system - a 100% solids, solvent-free two-component epoxy resin system thixotropic in nature and reinforced with fiberglass to minimize permeability, provide sag resistance and provide structural reinforcement.

2) Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating.

3) The spray equipment shall be specifically designed to apply the specified protective coating materials and shall be regularly maintained and in proper working order.

4) Installation. Specified surfaces shall be coated by spray application of Tnemec 436 moisture tolerant, solvent-free, 100% solids, epoxy protective coating. Spray application shall be to the following wet film thickness: 100 mils minimum thickness

c. Contractor Prequalification.

1) Certification from coating manufacturer that Applicator has been trained and approved in the handling, mixing and application of the products to be used.

2) Certification by Tnemec that the equipment to be used for applying the products has been approved and Applicator personnel have been trained and certified for proper use of the equipment.

3) Two (2) years experience and five (5) recent references of projects of similar size and scope.

H. Tnemec 435 Modified Polyamine Epoxy.

1. Surface Preparation.

a. Protection. Vehicles, equipment, structures, or other nearby surfaces not to be coated, shall be protected from blasting products and overspray throughout all surface preparation and coating operations. Transitions into uncoated areas shall be neatly taped-off or otherwise protected.

b. Decontamination. Surfaces previously exposed to salts or other chemical service shall be decontaminated by high-pressure fresh water blasting, steam cleaning, or by any method to remove all surface contaminants and eliminate or reduce subsurface contaminants to an acceptable level. If detergents are used, they shall be completely rinsed off with plenty of fresh water.

c. Abrasive Blast Cleaning for External Coating.

1) Surfaces shall be cleaned as per SSPC Standard SP-10, "Commercial Blast Cleaning."

2) Immersed surfaces to receive an external coating shall be abrasive blasted per SSPC Standard No. SP-10, "Near-White Blast Cleaning" with a 3 mil surface profile. Blast or grind irregular surfaces to same condition as flat surfaces. Sharp edges shall be ground down and rounded.

d. Cleaning of Adjacent Areas. After abrasive blasting is completed, areas adjacent to the work area shall be cleaned of dirt, blasting residues and other debris to prevent wind-blown contamination of the prepared substrate or freshly applied coatings.

e. Final Cleaning Before Application of Primer. Just prior to primer application, surfaces to be coated shall be power vacuumed to remove all dust and blasting residues. Transitions into adjacent areas not to be coated shall be neatly taped off or otherwise protected. Steel surfaces must be absolutely dry and dust-free prior to and during application of the primer.

2. Application.

a. Tnemec 435 Perma-Shield FR coating system

1) Tnemec 435- A Modified Polyamine Epoxy. A thick film, 100% solids two-component epoxy resin system, abrasion-resistant lining specifically designed for wastewater immersion and fume environments. Provides low permeation to H_2S gas, protects against MIC and provides chemical resistance to severe wastewater environments.

2) Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating.

3) The spray equipment shall be specifically designed to apply the specified protective coating materials and shall be regularly maintained and in proper working order.

4) Installation. Specified surfaces shall be coated by spray application of Tnemec 435 moisture tolerant, solvent-free, 100% solids, epoxy protective coating. Spray application shall be to the following wet film thickness: 30 mils (760 microns) in one or two coats.

b. Contractor Prequalification.

1) Certification from coating manufacturer that Applicator has been trained and approved in the handling, mixing and application of the products to be used.

2) Certification by Tnemec that the equipment to be used for applying the products has been approved and Applicator personnel have been trained and certified for proper use of the equipment.

3) Two (2) years experience and five (5) recent references of projects of similar size and scope.

I. Fusion Bonded Epoxy Coating

1. Surface Preparation. In accordance with coating manufacturer’s recommendations.
2. Application. In accordance with coating manufacturer’s recommendations.

3.6 PIPE PAINTING AND IDENTIFICATION

A. All pipelines in the project which are exposed to view in buildings, above suspended ceilings, or exposed above grade, and all exterior lines shall be identified by color and signs. Each pipeline shall be identified by a color complying with the following schedule of colors and further identified by applied markers.

B. Pipes which are exposed in areas requiring protective coatings shall be coated in accordance with the specifications for protective coating. Other pipes shall be painted in accordance with the specifications for decorative painting.

C. Pipes shall be coated in the number of coats and type of material specified for protective coating and decorative painting. Base coats for pipeline painting may be the same neutral color. Each succeeding base coat shall be a slightly different color. The final coat shall comply with the pipe identifying color schedule.

D. Pipeline identification markers shall be applied to all pipe, whether coated or uncoated.

E. Identify all pipelines with applied signs or markers at 15-foot centers, at both sides of penetrated walls or floors, adjacent to valves, at connected equipment, at branch fittings, and in congested pipe layouts.

F. All identification lettering shall be black with exception to pipe color Medium Brown, Red, and Safety Purple in which the letter color is white

G. Electrical conduit shall be painted to match adjacent ceiling or wall colors. Vent lines shall be painted to match surfaces they adjoin.

H. Valve handwheels and levers shall be painted red.

I.

1. Color Code Schedule. Per TCEQ §217.329 Color Coding of Pipes:

Piping System	**Legend or Tag**	**Color**	**AMS. STD. NO.**
Sludge (MLQ)	Sludge	Dk. Brown	10080
Primary Sludge	Primary Sludge	Med. Brown	10091
Return Activated Sludge	Return Sludge	Brown	10055
Waste Activated Sludge	Waste Sludge	Yellow-Brown	10266
Thickened Activated Sludge	Thickened Sludge	Dk. Brown	10080
Natural Gas*	Natural Gas	Red	11105
Potable Water	Potable Water	Light Blue	15450
Chlorine	Chlorine	Yellow	23655
Chlorine Gas	Chlorine Gas	Safety Yellow	13591
Chlorine Solution	Chlorine Solution	Safety Yellow w/ Red bands	13591 w/ 11105
Sodium Hypochlorite	Bleach	Safety Yellow w/ Red bands	13591 w/ 11105
Sulfur Dioxide	Sulfur Dioxide	Lime Green with Yellow Bands	34230 w/ 23655
Sewage (RAW)	Sewage	Grey	16251
Compressed Air	Compressed Air	Light Green	34540
Heated Water	Heated Water	Blue With 6-Inch Red Bands Spaced 30 Inches Apart	15180 w/ 11105
Power Conduit	Power Conduit	In compliance with The National Fire Protection Association 70 National Electrical Code®	
Reclaimed Water	Reclaimed Water	Purple with Black Lettering	17100 w/ 17038
Gray Water	Gray Water	Purple with Yellow Writing	17100 w/ 23655
Instrument Air	Instrument Air	Light Green with Dark Green Bands;	34540 w/ 34062
Liquid Alum	Liquid Alum	Yellow with Orange Bands	23655 w/ 12473
Alum (Solution)	Alum (Solution)	Yellow with Green Bands	23655 w/ 14115
Ferric Chloride	Ferric Chloride	Brown with Red Bands	10055 w/ 11105
Ferric Sulfate	Ferric Sulfate	Brown with Yellow Bands	10055 w/ 23655
Polymers	Polymers	White with Green Bands	17875 w/ 14115
Ozone	Ozone	Stainless Steel with White Band	SS w/ 17875

Piping System	**Legend or Tag**	**Color**	**AMS. STD. NO.**
Raw Water	Raw Water	Tan	20260
Effluent after Clarification	Effluent after Clarification	Dark Green	34062
Other non TCEQ Defined Systems and Required colors			
Fire Mains	Fire	Red w/ White bands spaced 6-inched apart	11105 w/17875
Process Air	Process Air	Steel	SS
Grit	Grit	Dk. Gray	16081
Scum	Scum	Lt. Brown	10324
Plant Drain	Plant Drain	Lt. Gray	16515
Potassium Permanganate	Potassium Perm	Safety Yellow w/ Brown bands	13591 w/ 10055
Caustic	Caustic	White w/Safety Red bands	17875 w/ 11105

*To be used within WWTP ONLY. For use outside of WWTP, Natural Gas to be Yellow No. 23655.

1. A non-potable water pipe must be painted purple and be stenciled "NONPOTABLE WATER, DO NOT DRINK" and "NO BEBA EL AGUA."

3.7 INSPECTION AND TESTING

A. Inspection.

1. The Contractor shall provide OSHA-approved staging, scaffolding and lighting as required to permit proper inspection as outlined in these specifications.

2. Surface preparation, coating application and repairs are subject to inspection by the Engineer. The standards published by the Steel Structures Painting Council, especially SSPC-VISL-635, Pictorial Surface, will be used as guides for acceptance or rejection of the cleaning, painting or coating application. Particular attention will be given hard-to-reach areas, bolted connections, supports, anchor bolts and threaded joints.

3. A magnetic-type dry film thickness gauge, and an electrical holiday detector will be used to determine the acceptability of the paint application. Calibration of the magnetic thickness gauge will be done on the site using the U.S. Department of Commerce, Bureau of Standard Film Thickness Calibration Standards.

4. Give sufficient notice in advance of coating applications so that the Engineer can perform the following inspections:

   a. Examination and approval of surface preparation prior to any coating.
   b. Examination and approval of each coat prior to application of the next coat.
   c. Inspection of the completed coating for runs, overspray, roughness, and any evidence of improper application.
   d. Direction or observation of testing.

B. Testing.

1. The following tests will be conducted:

   a. Dry film thickness will be tested after each coat of interior and exterior paint has been applied, and after final coat of the exterior system has been applied to the pump, motor, piping and appurtenances. A test will be made for every 25 square feet of surface and at locations designated by the inspector.
   b. All paint systems will be tested for holidays after the final coat has been applied.

2. Should any paint system fail to pass a test, the Engineer will specify corrective measures. The paint system will then be retested. Additional expenses including retesting will be charged to the Contractor.

END OF SECTION

SECTION 10440

INTERIOR SIGNAGE

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Panel signs.
2. Room-identification signs.
3. Field-applied, vinyl-character signs.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs: Not less than 12 inches square, including corner.
2. Room-Identification Signs: Full-size Sample.
3. Field-Applied, Vinyl-Character Signs: Full-size Sample of characters on glass.
4. Variable Component Materials: 8-inch Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
5. Exposed Accessories: Full-size Sample of each accessory type.

E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

F. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products and an entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - P R O D U C T S

2.1 PANEL SIGNS, GENERAL

A. Regional Materials: Panel signs shall be manufactured within 500 miles of Project site.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of panel sign to withstand design loads as indicated on Drawings.

B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Source Limitations. Obtain each sign type through one source from a single manufacturer.

D. Regulatory Requirements. Comply with the Americans with Disabilities Act (ADA), Texas Accessibility Standards and with code provisions as adopted by authorities having jurisdiction to provide signage as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to, the following:

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.
2. Fire Doors.
3. Room Capacity.
4. Live Load Capacity.
5. Signs for Accessible Spaces.
6. Room Identification. Indicating room numbers and accessible restrooms. Room numbers may also be affixed to Changeable Message and Conference room signs.
7. Signs for Accessibility Elements. International Symbols of Accessibility that are used to identify elements within facilities including “Volume Control,” “Text” Telephones, and “Assisted Listening Systems.”

2.3 SIGNS

A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Solid-Sheet Sign and Returns, Returns, and Back: Aluminum

2. Thickness: Manufacturer's standard for size of sign.
   a. Surface-Applied Graphics: baked enamel or powder coat.
   b. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
   c. Inset, Cutout Characters: Sign face routed to receive push-through acrylic graphics flush with the sign panel.

3. Laminated Aluminum-Sheet Sign: Aluminum sheet laminated to both sides of acrylic core sheet with painted edges.

a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
b. Surface-Applied Graphics: Applied vinyl film or paint.

4. Laminated Polycarbonate-Sheet Sign: Polycarbonate face sheet laminated to each side of phenolic base sheet to produce composite sheet.

a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
b. Surface-Applied Graphics: Applied vinyl film.

5. Engraved Plastic-Laminate Sign: Plastic-laminate face laminated to contrasting phenolic core to produce composite sheet.

a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
b. Engraved Graphics: Characters engraved through plastic-laminate face sheet to expose contrasting phenolic core.
c. Plastic-Laminate Color and Pattern: As selected by Architect from manufacturer's full range.
d. Core Color: Manufacturer's standard dark color.

6. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition Square cut.
b. Corner Condition in Elevation: Square.

7. Frame: Entire perimeter.

a. Material: Aluminum.
b. Material Thickness: Manufacturer's standard for size of sign.
c. Frame Depth: As indicated.
d. Profile: Square.
e. Corner Condition in Elevation: Square.
f. Finish and Color: As selected by Architect from manufacturer's full range.

8. Mounting: Manufacturer's standard method for substrates indicated, concealed stainless steel anchors.
9. Surface Finish and Applied Graphics:

a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
c. Integral Stainless-Steel Finish: No. 4.
d. Integral Acrylic Sheet Color: As selected by Architect from full range of industry colors.
e. Baked-Enamel or Powder-Coat Finish and Graphics: as selected by Architect from manufacturer's full range.
f. Painted Finish and Graphics: Manufacturer's standard, factory-applied exterior-grade sign paint, in color as selected by Architect from manufacturer's full range.
g. Overcoat: Manufacturer's standard baked-on clear coating.

10. Text and Typeface: typeface as indicated by manufacturer's designation.
11. Flatness Tolerance: Sign panel shall remain flat or uniformly curved under installed conditions as indicated and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

B. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: subject to compliance with requirements, provide products for one of the following:

    a. ACE Sign Systems, Inc.

    b. Allen Industries Architectural Signage

    c. Seton Identification Products.

    d. Best Sign Systems Inc.

    e. Mohawk Sign Systems.

    f. APCO Graphics, Inc.
2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to phenolic backing sheet to produce composite sheet.

    a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    b. Surface-Applied Graphics: Applied vinyl film.
    c. Subsurface Graphics: Slide-in changeable insert.
    d. Color(s): As selected by Architect from manufacturer's full range.

3. Sign-Panel Perimeter: Finish edges smooth.

    a. Edge Condition: Square cut.
    b. Corner Condition in Elevation: Square.

4. Mounting: Manufacturer's standard method for substrates indicated.
5. Text and Typeface: Characters should be Sans Serif. Accessible raised characters 1/32” above background and Braille (Grade 2). Finish raised characters to contrast with background color, and finish Braille to match background color.

2.4 FIELD-APPLIED, VINYL-CHARACTER SIGNS

A. Field-Applied, Vinyl-Character Sign: Pre-spaced characters die cut from 3- to 3.5-mil thick, weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.

B. Manufacturers: subject to compliance with requirements, provide products for one of the following:
    1. Manufacturers: subject to compliance with requirements, provide products for one of the following:
    2. ACE Sign Systems, Inc.
    3. Allen Industries Architectural Signage
    4. Seton Identification Products.
    5. Best Sign Systems Inc.
    6. Mohawk Sign Systems.
    7. APCO Graphics, Inc.

2.5 PANEL-SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

D. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

E. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.

F. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.

G. PVC Sheet: Manufacturer's standard, UV-light stable, PVC plastic.

H. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 0.048-inch nominal thickness.

I. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.

J. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.6 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
    b. Fastener Heads: For nonstructural connections, use screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
    b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
    c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

5. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.

B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

C. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

D. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability and for securing fasteners.
6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.

1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.

C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fish-mouths.

F. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.
2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.

3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. Revise "Brackets" Paragraph below to suit Project. Some manufacturers offer standard brackets for wall, railing, ceiling, and earth-stake applications.

G. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.
2. Stainless-Steel Brackets: Factory finish brackets to match sign background finish unless otherwise indicated.

2.8 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.10 METALLIC-COATED STEEL FINISHES

A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780/A 780M.

B. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.

C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.

2.11 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Directional Satin Finish: No. 4.
3. Dull Satin Finish: No. 6.
4. Reflective, Directional Polish: No. 7.
5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Verify that electrical service is correctly sized and located to accommodate signs.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.

C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
7. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
8. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.
9. Shim-Plate Mounting: Provide 1/8-inch-thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate.

D. Field-Applied, Vinyl-Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fish-mouths. Remove carrier film without disturbing applied vinyl film.

E. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 10520

FIRE EXTINGUISHERS

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Owner-Furnished Material: Hand-carried fire extinguishers.

C. Related Requirements:

1. Section 10522 "Fire Extinguisher Cabinets and Accessories."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:

a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.7 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - P R O D U C T S

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Babcock Davis.
b. Guardian Fire Equipment, Inc.
c. Larsens Manufacturing Company.
d. Potter Roemer LLC.
e. Pyro-Chem; Tyco Fire Suppression & Building Products.
f. Strike First Corporation of America (The).

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Stored-Pressure Water Type: UL-rated 2-A, 2.5-gal. nominal capacity, with water in stainless-steel container; with pressure-indicating gage.

C. Stored-Pressure Antifreeze Water: UL-rated 2-A, 2.5-gal. nominal capacity, with water and approved antifreeze solution mixed for temperatures as low as minus 40 deg F in stainless-steel container; with pressure-indicating gage.

D. Pressurized, AFFF-Foam Type: UL-rated 2-A:10-B, 1.6-gal., 3-A:20-B, 2.5-gal. nominal capacity, with AFFF foam in stainless-steel container; with pressure-indicating gage.

E. Pressurized, FFFP-Foam Type: UL-rated 3-A:20-B, 2.5-gal. nominal capacity, with FFFP foam in stainless-steel container; with pressure-indicating gage.

F. Wet-Chemical Type: UL-rated 2-A:1-B:C:K, 1.6-gal., 2.5-gal. nominal capacity, with potassium [acetate] [citrate] [carbonate]-based chemical in stainless-steel container; with pressure-indicating gage.

G. Regular Dry-Chemical Type: UL-rated nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.

H. Regular Dry-Chemical Type in Aluminum Container : UL-rated [2-B:C, 1-lb] [10-B:C, 2.5-lb] [10-B:C, 5-lb] [40-B:C, 5.5-lb] [60-B:C, 10-lb] [120-B:C, 20-lb] nominal capacity, with sodium bicarbonate-based dry chemical in enameled-aluminum container.

I. Multipurpose Dry-Chemical Type: UL-rated nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

J. Multipurpose Dry-Chemical Type in Aluminum Container : UL-rated [1-A:10-B:C, 2.5-lb] [2-A:10-B:C, 5-lb] [3-A:40-B:C, 5-lb] [3-A:40-B:C, 6-lb] [4-A:60-B:C, 10-lb] [10-A:120-B:C, 20-lb] nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

K. Purple-K Dry-Chemical Type in Aluminum Container : UL-rated [10-B:C, 2.5-lb] [30-B:C, 5-lb] [120-B:C, 20-lb] nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.

L. Carbon Dioxide Type : UL-rated [5-B:C, 5-lb] [10-B:C, 10-lb] [10-B:C, 15-lb] [10-B:C, 20-lb] nominal capacity, with carbon dioxide in enameled-aluminum container.

M. Halon Type : UL-rated [5-B:C, 2.5-lb] [10-B:C, 5-lb] nominal capacity, in enameled-steel container; with pressure-indicating gage.

N. Clean-Agent Type in Aluminum Container :UL-rated [1-B:C, 1.4-lb] [2-B:C, 2.5-lb] [5-B:C, 5-lb] nominal capacity, with HCFC Blend B agent and inert material in enameled-aluminum container; with pressure-indicating gage.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Babcock Davis.
b. Guardian Fire Equipment, Inc.
c. Larsens Manufacturing Company.
d. Potter Roemer LLC.
e. Pyro-Chem; Tyco Fire Suppression & Building Products.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical or horizontal.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inchesabove finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 10525

FIRE EXTINGUISHER CABINETS AND ACCESSORIES

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Requirements:

1. Section 10520 "Fire Extinguishers."

1.3 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire-protection cabinets including, but not limited to, the following:

a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semi-recessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

1. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Samples for Initial Selection: For each type of exposed finish required.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches square.

F. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.7 SEQUENCING

A. Apply decals, vinyl lettering on field-painted fire-protection cabinets after painting is complete.

PART 2 - P R O D U C T S

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Babcock Davis
b. GMR International Equipment Corporation
c. Guardian Fire Equipment, Inc.
d. Larsens Manufacturing Company
e. Potter Roemer LLC
f. Strike First Corporation of America (The)

B. Cabinet Construction: Nonrated, 1-hour fire rated, 2-hour fire rated, matching the fire rating of the partition where it is mounted.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Aluminum sheet.

1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet:

1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as drywall bead.
2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

F. Cabinet Trim Material: Same material and finish as door.

G. Door Material: Aluminum sheet.

H. Door Style: Fully glazed panel with frame.

I. Door Glazing: Tempered float glass (clear).

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide manufacturer's standard hinge permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
4. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

    a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER".

        1) Location: Applied to cabinet door.
        2) Application Process: Decals, Pressure-sensitive vinyl letters.
        3) Lettering Color: Red.
        4) Orientation: Vertical or Horizontal, as acceptable to authorities having jurisdiction.

6. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by batteries.

L. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

    a. Finish: Baked enamel or powder coat.
    b. Color: As selected by Architect from full range of industry colors and color densities.

2. Aluminum: ASTM B 221, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet. ASTM B 221 for extruded shapes.

    a. Finish: Baked enamel or powder coat.
    b. Color: As selected by Architect from full range of industry colors and color densities.

3. Stainless Steel: ASTM A 666, Type 304.

    a. Finish: No. 4 directional satin finish.

4. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, 3 mm thick.
5. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
6. Break Glass: Clear annealed float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.
7. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
8. Wire Glass: ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.
9. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 6 mm thick, with Finish 1 (smooth or polished).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
4. Fire-Rated Cabinets:

    a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
    b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

C. Identification: Apply decals or vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10700

EXTERIOR SUN CONTROL DEVICE

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

Custom Sunshades as shown on the drawings, as specified, and as needed for a complete and proper installation. The shade structure manufacturer/supplier shall be responsible for the design, engineering, fabrication, supply, and installation of the work specified herein. The intent of this specification is to have only one single manufacturer/supplier be responsible for all the above functions.

1.3 REFERENCES

A. Shade structures must comply with the latest revision of applicable codes and regulations including IBC 2018, or the latest revision required by the City.

1.4 COORDINATION

A. Coordinate sunshade location with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.5 SUBMITTALS

A. Product Data: Submit specifications, data, and installation, instructions from the manufacturer of the Sunshades.
   1. Provide fabric color range and powder coat color selections.

B. Submit shop drawings for the system. Show anchorage, details and connections for all the component parts.
   1. Drawings shall include elevations, sections and specific details for each unit, condition.
   2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   3. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   4. Include electrical characteristics.

C. Quality Assurance:
   1. Single manufacturer/supplier responsibility: Subcontract the work to a single firm that has a minimum of ten years' experience in the design and manufacturing of work similar to that shown and required.
   2. Performance requirements: Design sunshades to accommodate local requirements for wind loading. Provide engineering calculations to support design. Calculations to be sealed by an engineer registered and licensed in the State of Texas.
   3. Provide proof of installed reference sites with five structures for similar scope of project and installation that are engineered to IBC 2018 specifications, or the latest revision required by the city, Include in reference list sizes and design style of structures with install dates and project locations.
   4. Design, fabrication and erection are limited to fabric architecture firms with engineering in tensile shade structures and proven experience in design and construction of fabric shade structures and such firms shall meet the following minimum requirements. No Substitutions shall be allowed for the following:
      a. A single shade manufacturer/supplier shall design, engineer, manufacture and erect the fabric shade structures including the foundations.
      b. All manufacturers/suppliers shall have at least 10 years' experience in the design, engineering, manufacture, and installation of structures, engineered with similar scope and a successful construction record of in-service performance.
      c. All manufacturer/supplier must have an in-house warranty & service department and local office to assist in repairs and service calls.

1.6 PROJECT CONDITIONS

A. A. Field Measurements: Verify layout information for shade structures shown on the project drawings in relation to the site plan and adjacebt structures and verify locations by field measurements prior to construction for shade structures.

B. Contractor shall coordinate sunshade location and installation. Adjustments to foundation locations or positioning shall not be an acceptable basis for cost adjustment. The contractor will coordinate with shade manufacturer to determine/verify what access is available to the installation site for various required equipment.

1.7 WARRANTY

A. Provide written warranty to the owner that all labor and materials for a period of two years from date of installation.

B. A supplemental warranty from the manufacturer shall be provided for a period of 10 years (prorated) on fabric and 10 years on the structural integrity of the steel from date of substantial completion.

C. The warranty shall not deprive Owner of other rights under the provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by Contractor under requirements of the Contract Documents.

PART 2 - P R O D U C T S

2.1 GENERAL

A. Acceptable manufacturers:
1. Tenso Shade, LLC
17595 W Blanco Rd. Ste 300
San Antonio, Texas. 78232
(210) 888-0128,
Info@TensoShade.com
www.TensoShade.com
2. Approved substitution.

B. All shade structures are engineered and designed to meet a minimum of 90 mph wind load, Exposure C and a live load of 5 lbs./sf². All shade structures shall be engineered with a zero wind pass-through factor on the fabric. When ASD Steel Design Method is used based on IBC 2012 Section 1605.3.1 the Dead + 0.75 of Live + 0.75 of Wind Load cases must be combined.

2.2 PRODUCT DESCRIPTION

A. (1 Bay) 36' x 52' x 20' ht. – 6-Pole HIP Fabric Shade Structure MAYASUPRA™ model. Including:

B. (1 Bay) 36' x 52' x 20' ht. – 6-Pole HIP Fabric Shade Structure MAYASUPRA™ model. Including:
1. Tensile shade structure fabrication,
2. Structure finishing (Powder Coated)
3. Shade cloth membrane paneling manufacturing and alteration
4. Complete project freight and handling
5. Complete structure Installation
6. Embedded Columns with concrete piers flush to grade

C. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

2.3 FABRIC STRUCTURE

A. Steel:
1. Refer to Section 05120 Structural Steel Framing. All framing shall be 316L stainless steel.

B. Bolts:
1. Refer to Section 05120 Structural Steel Framing.

C. Welding:
1. Refer to Section 05120 Structural Steel Framing.
2. All shop-welded connections of the shade structure shall be designed conforming to the current adopted version of the International Building Code 2012 and local agency additions and amendments. Structural welds shall be made in compliance with the

requirements of the "Prequalified" welded joints where applicable and by certified welders. No onsite or field welding shall be permitted.

3. All full penetration welds shall be continuously inspected by an independent inspection agency and shall be design conforming to the current adopted version of the International Building Code 2018 and local agency additions and amendments.

D. Powder coating:

1. 1. Galvanized steel tubing preparation prior to powder coating shall be executed in accordance to solvent cleaning SSPC-SP1. Solvent such as water, mineral spirits, xylol, toluol, which are to be used to remove foreign matter from the surface. A mechanical method prior to solvent cleaning prior to surface preparation shall be executed according to Power Tool Cleaning SSPC-SP3 and utilizing wire brushes abrasive wheels and needle gun, etc.
2. Structural stainless steel tubing preparation prior to powder coating shall be executed in accordance to commercial blast cleaning SSPC-SP6 or NACE #3. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion, products and other foreign material.
3. Powder coating shall be sufficiently applied, with a minimum three mils thickness and cured at the recommended temperature to provide proper adhesion and stability to meet salt spray and adhesion tests as defined by the American Society of Testing Materials.
4. Powder used in the powder coat process shall have the following characteristics:
   a. Specific Gravity: 1.68 +/- 0.05
   b. Theoretical coverage: 114 +/- 4ft^2/lb/mil
   c. Mass loss during cure: <1%
   d. Maximum storage temperature: 80^{o}F
5. TIGER Drylac® powder coating systems shall be applied in accordance with the manufacturers' specifications. Primer should be fused only and then top coated with the selected powder coat to ensure proper intercoat adhesion.

E. Tension Cable:

1. Stainless Steel cable is determined based on calculated engineering load.
2. For light and medium loads, 1/4" (nominal) 316 stainless steel 7x19 strand cable to be used.
3. For heavy loads, 3/8" (nominal) 316 stainless steel 7 x 19 cable to be used.

F. Fabric Roof Systems

1. 1. UV Shade Fabric
   a. UV shade fabric is made of a UV stabilized Synthesis® Commercial 95 Shade cloth HDPE high-density polyethylene mesh. Mesh shall be lock-stich knitted with monofilament and tape yarn filler to ensure that material will not unravel if cut. Panels to be at least 9ft wide.
   b. Fire Testing: Fabric shall conform and pass the ASTM E-84 (Class A), California Fire Marshall and NFPA No. 225, and UBC No. 8-1.
   c. The fabric knot is to be made using monofilament and tape filler, which has a weight of 340g per square meter.
   d. Shade cloth designed to provide UV block ranging from 91% to 98% creating safer outdoor daytime environments which can be utilized for longer periods.
2. 2. Fabric Properties:
   a. Life Expectancy: A minimum of 10 years continuous exposure to the sun
   b. Fading: Minimum fading after 5 years (3 years for red and yellow)

c. Fabric Mass: 10 1/2 oz/sqft (340g/sm)
d. Fabric Width: 9.8425 (3m)
e. Roll Length: 164.04 (50m)
f. Roll Dimensions: 62.99”x16.5354” (160 cm x 42 cm)
g. Roll Weight: +/- 122 lbs
h. Minimum Temperature: -22°F
i. i. Maximum Temperature: +167°F

3. ` 3. Stitching & Thread:
   a. All sewing threads are to be double stitched.
   b. Thread shall be GORE Tenara Sewing Thread manufactured from 100% expanded PTFE (Teflon); mildew resistant exterior approved thread. Thread shall meet or exceed the following:
      1) Flexible temperature range
      2) Very low shrinkage factor
      3) Extremely high strength, durable in outdoor climates
      4) Resists flex and abrasion of fabric
      5) Unaffected by cleaning agents; acid rain, mildew, salt water and rot resistant, unaffected by most industrial pollutants
      6) Treated for prolonged exposure to the sun

2.4 SHIPPING AND HANDLING

A. All steel surfaces touched by tie down straps are to be padded before final clinching. This can be accomplished by using carpet pads or factory manufactured padding.

B. All dunnage must be padded before painted products are set in place. Smaller and loose pieces must be padded and totally separate from paint padding.

C. Unloading: Lift forks to be covered with properly fitted padding. All dunnage must be padded vertically and horizontally to prevent damage to painted surfaces. When unloading, take care to prevent tools and other hard surface items from making contact with painted items.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. A. Installations of shade structures shall be by the approved manufacturer.

B. The contractor installing, if any, the structure shall comply with manufactures instructions for assembly, installation, and erection per approved drawings.

C. Concrete
   1. See Division 3, concrete.

D. Foundations:
   1. All Anchor Bolts set in new concrete shall be as defined in specification Section 05500 Miscellaneous Metals.
   2. Footings shall be a minimum as listed below:

a. The minimum footing size for the shade structure is in accordance with and conforming to manufactures engineered specifications and drawings.

3.2 SAFETY PROCEDURES

A. The Contractor is responsible for the coordination of work with other trades.

B. All staff personnel are to be dressed and conduct themselves in accordance with OSHA standards. All staff must be properly trained for equipment that they might use. Safety is a top priority.

C. All vehicles and machinery must be operated by licensed operators in accordance with OSHA standards. All cranes and lifts must be operated in accordance with manufacturer's guidelines.

D. The handling of steel during installation is critical. Exercise care when lifting items so that it does not come into contact with other surfaces. Clean sand and other deleterious material from structural items before moving or lifting. Before installation, all items are to be washed with soap and water and dried with cloths. All grease, dust, oils, and other latent materials are to be removed during this washing. When pouring concrete pour backs at columns, protect paint by using plastic and tape to prevent concrete from splashing on finish surfaces.

E. All concrete must be cut with a wet diamond blade to ensure that it leaves a clean finish. If at any stage the existing remaining surface lifts, creating a tripping hazard, additional saw cutting will be required so as to leave a neat and uniform joint.

F. Cover all open holes at all times with solid plywood and spoils to prevent access until concrete is poured.

G. All equipment and/or product must be stored inside the fenced area per manufactures requirements.

END OF SECTION

SECTION 10800

TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 - G E N E R A L

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Private-use washroom accessories.

B. Related Requirements:
   1. Section 09310 "Ceramic Tile" for ceramic toilet and bath accessories.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Include electrical characteristics.

B. Samples: Full size, for each exposed product and for each finish specified.

   1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

   1. Identify locations using room designations indicated.
   2. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - P R O D U C T S

2.1 OWNER-FURNISHED MATERIALS

A. Owner-Furnished Materials: Confirm with owner.

2.2 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.

2.3 PRIVATE-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Toilet Tissue (Roll) Dispenser:
1. Basis-of-Design Product: B-2888 Classic Series Surface-Mounted Multi-Roll Toilet Tissue Dispenser .Subject to compliance with requirements, provide products by Bobrick Washroom Equipment, Inc. or a comparable product from one of the following:
   a. Bradley Corporation.
   b. American Specialties, Inc.
2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with theft-resistant spindle.
5. Capacity: Designed for 5-inch-diameter tissue rolls.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Combination Towel (Folded) Dispenser/Waste Receptacle :
1. Basis-of-Design Product: B-38032 Paper Towel Dispenser and Waste Receptacle with 3803-130 TowelMate. Subject to compliance with requirements, provide products by Bobrick Washroom Equipment, Inc. or a comparable product from one of the following:
   a. Bradley Corporation.

b. American Specialties, Inc.

2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
3. Mounting: Semi-recessed.

a. Designed for nominal 4-inchwall depth.

4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
5. Minimum Waste-Receptacle Capacity: 6.3 gal.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
7. Liner: Reusable, vinyl waste-receptacle liner.
8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

D. Liquid-Soap Dispenser:
1. Basis-of-Design Product: B-2111 Soap Dispenser. Subject to compliance with requirements, provide products by Bobrick Washroom Equipment, Inc. or a comparable product from one of the following:
a. Bradley Corporation.
b. American Specialties, Inc.

2. Description: Designed for dispensing antibacterial soap in liquid or lotion.
3. Mounting: Vertically oriented, surface mounted.
4. Capacity: 40 oz..
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Valve: Black molded plastic push button and spout. Soap head-holding mushroom valve. Stainless Steel spring. U packing seal and duckbill. Antibacterial-soap-resistant plastic cylinder.
7. Lockset: Tumbler type.
8. Refill Indicator: Window type.

E. Sanitary-Napkin Disposal Unit :
1. Basis-of-Design Product: B-270 Sanitary Napkin Disposal.Subject to compliance with requirements, provide products by Bobrick Washroom Equipment, Inc. or a comparable product from one of the following:
a. Bradley Corporation.
b. American Specialties, Inc.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

F. Seat-Cover Dispenser :
1. Basis-of-Design Product: B-221 Seat-Cover Dispenser Subject to compliance with requirements, provide products by Bobrick Washroom Equipment, Inc. or a comparable product from one of the following:
a. Bradley Corporation.
b. American Specialties, Inc.
2. Mounting: Surface mounted.
3. Minimum Capacity: 250 seat covers.
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
5. Lockset: Tumbler type.

G. Mirror Unit:
1. Basis-of-Design Product: B-290 1836 Glass Mirror with Stainless Steel Angle Frame. Subject to compliance with requirements, provide products by Bobrick Washroom Equipment, Inc. or a comparable product from one of the following:
a. Bradley Corporation.

b. American Specialties, Inc.

2. Frame: 18-8 Heavy –Gauge Stainless-steel angle with satin finish.

a. Corners: Manufacturer's standard.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: 18 Inches(457 mm) by 36 inches (914mm).

H. Coat Hook:
1. Basis-of-Design Product: B-211 Heavy Duty Clothes Hook .Subject to compliance with requirements, provide products by Bobrick Washroom Equipment, Inc or a comparable product from one of the following:
a. Bradley Corporation.
b. American Specialties, Inc.
2. Description: Single-prong unit.
3. Material and Finish: Solid brass with satin nickel-plated finish.

2.4 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.5 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations.

B. Install all accessories in compliance with the Americans with Disabilities Act (ADA) and Texas Accessibility Standards (TAS) regulations governing mounting heights for handicapped accessibility where heights are not shown or scheduled on drawings.

C. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION

SECTION 11176

NON-POTABLE WATER BOOSTER SYSTEM

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of procurement and installation of the Non-Potable Water (NPW) system. The system shall be skid-mounted and shall include two (2) in-line vertical multi-stage design pumps, P-601 and 602, other equipment, valves, instruments and appurtenances specified herein and shown on the drawings or otherwise required for operation. System controls supplied by equipment manufacturer shall be designed to be capable of automatically providing a minimum system pressure over the specified range of demand flows. One pump operation under variable speed operation shall be designed to operate at 50 gpm at 130 feet of TDH, with second pump used for standby operation.

B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be approved by the Owner's Representative.

C. Single Source Responsibility: Pump vendor shall be responsible for the supply, service, and operation of all equipment specified herein. Pump vendor may rely on warranties of individual components to meet requirements of the specifications, but the pump vendor, along with the Contractor, will be responsible as the supplier/packager of the equipment for total system performance.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300 – Submittals, Section 01340, Shop Drawings, Product Data and Samples, and 01700, Contract Closeout.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Owner's Representative review.

C. Shop Drawings/Product Data. At a minimum, provide the following:

1. Make, model, weight, and horsepower of each pump.
2. Make, model, weight, catalog information for all appurtenances (e.g., valves, pressure control valves)
3. Complete catalog information, descriptive literature, specifications, and identification for all devices (e.g. electrical and control components).
4. Any exceptions to the specifications.
5. Performance data curves showing head, capacity, horsepower demand, NPSHr, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.
6. Clearly define the acceptable range of operation of the selected pumps, including flow rate at which up-thrust shall occur.
7. Detailed structural, mechanical, and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.
8. Power and control wiring diagrams, including terminals and numbers.
9. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications. See Section 16222 – AC Electric Motors – 100 HP and Below, for additional submittal requirements.
10. Manufacturer shall supply a written description of the control scenarios.
11. Factory finish system.

D. Quality Control Submittals. At a minimum, provide the following:

1. Provide certification of ability to provide field services for on the entire NPW system including and supply of all replacement parts for the system.
2. Factory Functional and Performance Test Reports and Log.
3. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified (see Section 09928 – Protective Coatings for Wastewater Systems).
4. Special shipping, storage and protection, and handling instructions.
5. Manufacturer's printed installation instructions.
6. Manufacturer's Certificate of Startup and Commissioning.
7. Suggested spare parts list to maintain the equipment in service for a period of 2 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
8. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

E. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for system as a whole, as well as individual manuals for all equipment. Provide operation and maintenance manuals in accordance with provisions of Section 01300 – Submittals, Section 01661- Instruction of Operation and Maintenance Personnel, and section 01730 Operation and Maintenance Data

1.3 WARRANTY

Provide equipment warranty in accordance with the requirements of Section 01700 – Contract Closeout.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. The NPW system shall be a skid-mounted system consisting of two (2) in-line vertical multi-stage design pumps and inverter rated motors (1 duty, 1 standby). System shall also include check valves, isolation valves, pressure sensors and indicators, related piping, and wiring. All equipment shall be mounted on a structural steel base to form a complete operating pumping station.

B. Variable frequency drive units shall be mounted in an adjacent A/C control panel supplied by pump manufacturer.

C. The manufacturer shall provide control panel for field mounting including pump control programming and system control panel hardware (see Section 13405 – Control System Operation, and Section 13413 – Control Panels). Manufacturer shall include control provisions to prevent system from operating outside the acceptable range, or at any point where the pumps may be damaged (such as flows were up-lift occurs). Manufacture to document these provisions in the Operations Manual.

D. See attached data sheet for P-601 and 602 for service conditions and general preferences for materials of construction. NPW Pump manufacturer is to select pump based on desired operating conditions and submit selection for approval.

E. The manufacturer shall be responsible for pump system controls. General control philosophy shall comply with the description and strategy outlined in Section 13405 Control System Operation.

F. The manufacture shall provide all instrumentation and control devices listed in Section 13405 or otherwhere called out in this specification, and as specified in Section 13421 instruments. Communication between NPW supervisory PLC and future plant SCADA system will be over ethernet, equipment supplier shall provide SCADA ready monitoring of pumps running, VFD speed, equipment failures, and discharge pressure.

2.2 ACCEPTABLE MANUFACTURERS

A. Provide equipment from one of the following acceptable manufacturers:

1. Grundfos
2. Owner/Engineer Approved Equal.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01600 – Materials and Equipment.

2.3 QUALITY ASSURANCE

A. Manufacturer shall have been in the business of assembling pump skid packages for more than 5 years.

B. Manufacturer to have at least ten (10) installations of similar systems (flow, pump type). Provide size, location, name and references for operator.

2.4 PRODUCT DESCRIPTION

A. Pump Skid. The pump skid shall be designed to support the loads and forces of the equipment supported upon it. All steel members shall be 304 stainless steel and appropriately sized. Lifting lugs or other appropriate lifting points shall be included on the skid allowing unloading and placement. Submit drawings for the skid assembly and layout.

B. Pumps.

1. Select pumps to operate conservatively over the entire range of total head as specified for each pump. Select pumps with head curves constantly rising toward shutoff and preferably with efficiency curves which peak at or to the left of rated conditions.
2. The pumps shall be in-line vertical multi-stage design pumps type pumps rated for outdoor operation. Each unit shall be equipped with a TEFC motor, completely shop assembled in the pump manufacturer's plant, accurately aligned and properly prepared for shipment.
3. The pumps shall be capable of handling biologically treated and filtered wastewater effluent. The pump discharge shall be above the pump base. The pump shall be supported from the base plate of the pump by a steel structure.
4. Pumps shall be capable of continuous operation, 24 hours per day 7 days per week.
5. Pumps shall be arranged in accordance with Hydraulic Institute Pump Intake Design Recommendations.
6. Manufacturer to provide appropriately sized inverter duty motor per Section 16222 – AC Electric Motors- 100 HP and Below.
7. Provide spare parts in accordance with requirements of Section 01700 – Contract Closeout.
8. See Contract Drawings for additional details. All electrical equipment shall be rated for outdoor use.

C. Valves. Valves shall be provided as specified in Section 15139 – Wastewater Valves and as shown on the Drawings.

D. Pre-pressurized Diaphragm Tank.

1. Minimum size of 53 gallons and maximum working pressure of 120 psig.
2. Diaphragm to be heavy duty Butyl NSF/ANSI 61.
3. System connection to be stainless steel.
4. Shell to be stainless steel.
5. Air valve to be projection welded.
6. Factory precharged to 50 psi.
7. Warranty to be five years.
8. Tank shall be as supplied by Varem-USA, or equal.

E. Piping and Piping Supports. NPW piping and piping supports shall be provided as specified in Section 15071 – Wastewater Piping; Section 15094 – Supports and Hanger; Section 15105 – Pipe and Pipe Fittings - General; and as shown on the Drawings. Piping shall be in accordance with Hydraulic Institute standards. Pump skid provider shall include all piping and valves from single 4" suction and 4" discharge piping shown on plans.

F. Sensors.

1. Pressure Gauge. A pressure gauge shall be provided for each pump discharge and the discharge header complete with isolation ball valves. All gauges shall be liquid filled to reduce wear due to vibration. Accuracy shall be within 1.5%. Gauge shall be provided as specified in Section 13421 –Instruments.
2. Pressure Transducer. Pressure transducer shall be mounted on the discharge header and shall provide all pressure signals for the control logic. Pressure transducer shall be as specified in Section 13421– Instruments and as shown on the Drawings. Transducer shall be rated for station discharge pressure as shown on pump schedule, and shall provide gauge pressure output, rather than absolute pressure. Pressure transducers constructed from plastic are not acceptable.

G. Controls.

1. Conform to requirements of specification Section 13413 – Control Panels.
2. NPW system operation: see Section 13405 – Control System Operation.

H. Sequence of Operation (PLC). See Section 13405 – Control System Operation.

I. Provide spare parts in accordance with requirements of Section 01700 – Contract Closeout. Recommended spare parts listed accordance with the provisions of that specification shall be provided.

J. All sensor output shall be available for future monitoring by the plant SCADA System.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600- Materials and Equipment and manufacturers/suppliers recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory as a complete unit for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Owner's Representative review.

B. Certification of all factory testing data and results shall be submitted for Owner and Owner's Representative review.

3.3 INSTALLATION

Install all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.4 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by the both the manufacturer's factory representative and the Owner's Representative.

B. Functional Tests. Conduct on each pump.

1. Alignment. Check and adjust complete assemblies for correct rotation, proper alignment and connection, and quiet operation as required.
2. Operating Temperatures. Monitor bearing areas on pump and motor for abnormally high temperatures.
3. Performance Test. In accordance with Hydraulic Institute Standards.

C. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Owner's Representative.

3.5 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655 – Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661 – Instruction of Operation and Maintenance Personnel.

Project: City of Galveston - Wastewater Treatment Plant

Service Tag Number: P-601 and P-602				
Pump Name: NPW (Non Potable Water)				
Manufacturer	(1) Grundfos		Model Number: *HYDRO MPC EC (CUE) 2CR 20-2	
	(2) Xylem – Bell & Gossett			
	(3) Owner/Engineer Approved Equal			
Service Conditions				
Liquid: Wastewater Treatment Plant Effluent. Water may have dissolved oxygen in excess of 6.0 mg/L with pH in the range of 6.0 to 9.0. Effluent will be filtered through cloth media filters per 30TAC 217.190 to meet effluent discharge permit of 5 mg/L average daily effluent BOD.				
System Flow Rate: The system will be required to deliver variable flows ranging from 40 gpm to 60 gpm in the pressure range of 40 to 60 psig (without excessive cycling of the pumps. Pumps should turn off if the system discharge flow is zero, so long as the number of start-stop cycles is within the design parameters of the motor.				
Fluid Temperature (degrees Fahrenheit):	Max 85 Min 50			
Specific Gravity at 60 degrees F: 1.0	Viscosity at 60 degrees F: (water)			
Vapor pressure at 60 degrees F:	0.26 psia			
Abrasive (Y/N): N (minor)	Possible Scale Build Up (Y/N): N			
Corrosion Caused By:	Dissolved Oxygen			
Diameter of Solids Pump Shall Be Capable of Passing:	*			
Min. NPSH Available (Ft, Absolute):	33			
Pump Location:	□ Indoor	□ Heated	Min Temp: 8 deg F	Altitude: 14 ft
	■ Outdoor	■ Unheated	Max Temp: 110 deg F	
Electrical Code Classification: Unclassified				
Performance Data				
Pump Type: Multi-Stage *				
BEP Conditions: *100 GPM @ 112'TDH – 72% Hydraulic Efficiency				
Operating Requirements: Pumps shall meet operating criteria by controlling pump rpm and recycling a portion of the pump discharge (if required).				
Nominal Pump Speed (full speed): 3600 rpm* (maximum allowable)				
Pump Speed Range: 2500 to 3600 rpm* (Manufacturer to confirm acceptable operation range of pump)				
System Design Point at 100% speed - approx:	0 gpm @ 136 ft TDH (dead head) 100 gpm @ 112 ft TDH (BEP) 150 gpm @ 65 ft TDH (maximum flow)			
Shutoff Head: ft*				
Run Out Point: ft*				
Max. Brake HP: 5* BHP				
Design and Materials				
Discharge Head:				
Type:	Above ground, Flanged Ends *, Cast			
Size:	4 inch*			
Material:	Ductile Iron, ASTM A536, Class 65*			
Connection:	4 inch*			

Pump Suction/Discharge:	
Material:	304 Stainless Steel, Class 150 ASTM A312*
Size:	4”*
Mating Flange:	Manufacturer’s Standard
Coupling Guard:	Required
Shafting:	
Shaft Material:	Type 431 Stainless Steel*
Stationary Ring:	Silicon Carbide*
Rotating Ring:	Silicon Carbide*
O-rings:	EPDM*
Impeller:	
Type:	Multi-stage*
Impeller Material:	304 Stainless Steel *
Rings	PTFE & Silicon Carbide*
Motor Base:	
Type:	Fabricated Steel 304 Stainless Steel
Drive Motor Specifications:	
Manufacturer:	*
Enclosure:	TEFC
Rated HP:	* HP (5 HP Max)
Frame:	*
Phase/Hz/Volts:	3/60/460
Weights and Measurements:	
Pump and Motor :	* Lbs
Other Details and Information:	

* Vendor Confirmed or Supplied Information.

END OF SECTION

SECTION 11215

JET AERATION SYSTEM

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision and installation of a jet aeration mixing system. Also required is the provision of a submersible pump for a complete system. The pump is specified under Section 11319 Submersible Pumps.

B. Provide one (1) jet aeration system complete with nozzle assemblies, design of the discharge piping, two (2) identical submersible chopper pumps (1 duty, 1 shelf spare), controls, and miscellaneous appurtenances. System shall be designed for aerating waste activated sludge (WAS) and scum containing biological solids and/or fibrous materials without clogging. Sludge Holding Tank shall operate at a maximum operating concentration of approximately 4% solids. The jet aeration mixing system design should account for obstructions including piping and supports from other mechanical systems required for decanting or air supply in the Sludge Holding Tank.

1. Contractor shall provide all suction and discharge piping inside the Sludge Holding Tank per the approved shop drawings for the nozzle mixing system.

C. The equipment furnished under this section shall be a submerged jet aeration system. The system shall be designed to uniformly oxygenate the mixed liquor and maintain suspension of biological solids. The system shall consist of jet aeration headers with a flush-out system, motive liquid pumps, connection to aeration system, and all in-basin liquid piping, air piping, and supports. The manufacturer shall be responsible for determining mixing assembly quantity, location and appropriate nozzle angles.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300, Submittals, and Section 01340, Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Owners Representative review.

C. Shop Drawings/Product Data. At a minimum, provide the following:

1. Catalog information including materials of construction
2. Performance curves
3. Complete specifications for each part to assure compliance with these specifications
4. Construction drawings showing complete dimensions, anchor bolts locations and flange details
5. Cross sectional drawing with detailed parts list for pumps and motors
6. Weights
7. Warranty
8. Factory test data & guaranteed pump efficiency at rated conditions
9. Recommended spare parts list for 1 year's normal maintenance.

D. Operation and Maintenance Manuals.

1. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730, Operation and Maintenance Data.
2. At a minimum, include maintenance instructions with frequencies, assembly views, lubrication instructions and replacement parts lists.

1.3 WARRANTY

Provide equipment warranty in accordance with the requirements of Section 01700, Contract Closeout.

1.4 REFERENCE STANDARDS

A. American Society of Testing Materials (ASTM)

1. ASTM D 2996 RTRP 12 EU-3111.

1.5 CERTIFICATION OF COMPLIANCE

A. The aeration system manufacturer shall include with the bid a Certification of Compliance, stating that the aeration system provided fully complies with the materials of construction stated herein, including all ASTM and National Bureau of Standards specifications listed in this section. A letter shall be included from the FRP pipe supplier stating that FRP pipe utilized for the project will be certified compliant to ASTM D 2996 RTRP 12 EU-3111. Additionally, all pipe and molded components must be manufactured in the U.S. A certification statement confirming this must be provided as part of the equipment submittal.

PART 2 - P R O D U C T S

2.1 GENERAL

A. The aeration system shall be installed as shown on the plans. The aeration system shall be designed to transfer 42 lbs. of standard oxygen per hour at design conditions. The system shall be furnished in accordance with the following specifications and as shown on the plans.

2.2 JET AERATION HEADER

A. One (1) aeration header shall be provided. The jet aeration header shall be comprised of a liquid duct, an air duct, and a minimum of two (2) jet aerator assemblies. The header shall be constructed such that the liquid duct, air duct, and jet aerator assemblies comprise one self-contained unit, and shall be shipped as such; complete and ready for installation. Headers in excess of forty (40) feet in length may be shipped in sections. A maximum of one "field joint" may be required for each forty (40) feet of header length.

B. The liquid duct shall be a cylindrical member having a plurality of liquid nozzle entry orifices which are longitudinally spaced along its perimeter and aligned on a common horizontal plane. The inner surface of the liquid duct shall be smooth and free of protrusions which might collect stringy material.

C. The air duct shall also be a cylindrical member which is parallel to and above the liquid duct. The air duct shall be joined to, and supported by, the air manifolds, and additional support points as necessary. The air duct shall have a plurality of air manifold entry orifices longitudinally spaced along it's perimeter, in corresponding number to, and in vertical alignment with the liquid nozzle entry orifices of the liquid duct. The provision of separate air entry manifold with a fixed orifice for each jet assembly shall insure uniform air distribution.

D. The liquid and air ducts shall be machine filament wound fiberglass reinforced thermosetting resin pipe. Liquid and air ducts shall be fabricated in strict accordance with ASTM Specification D-2996-01. Hand

filament wound FRP piping (fabricated in accordance with NBS specifications), PVC or other thermoplastics are not acceptable. Minimum acceptable pipe wall thickness (including corrosion liner) shall be per the following table:

Diameter	Wall Thickness
4”	0.104
6”	0.146
8”	0.146
10”	0.188
12”	0.188
14”	0.230
16”	0.272
18”	0.272
20”	0.314
24”	0.356
30”	0.440

E. The minimum pressure rating of the aeration header shall be 75 PSI. Minimum pressure rating is an internal rating and must have a minimum 5:1 safety factor against short term burst hoop tensile strength and 1.8:1 safety factor against long term hydrostatic design basis. For systems utilizing flush-out, the header shall be designed for an appropriate external PSI vacuum rating for the service conditions and shall have a minimum of 3:1 safety factor against hoop tensile strength. Manufacturer shall be able to provide calculations and structural wall thickness in regard to the intended service conditions. Additionally, the submittal must include a letter from the FRP pipe supplier stating that the pipe for this project is certified compliant to ASTM D 2996 RTRP 12EU-3111.

F. Each jet aerator assembly shall consist of an inner liquid nozzle and an outer air/liquid delivery nozzle. The inner and outer nozzles shall be aligned on a common centerline, joined together, and laminated to form a single unit. The jet aerator assembly shall be joined to the liquid duct and the air manifold and laminated for strength to form a single integrated unit. Systems with non-integral jets will not be accepted. The matting surface of the jet aerator assembly shall match the contour of the liquid duct and be stepped to match the liquid nozzle entry orifices of the liquid duct to ensure proper alignment and provide a smooth contoured liquid flow path. No portion of the liquid nozzle or aerator assembly shall protrude into the liquid duct.

G. In order to reduce plugging potential, the liquid nozzles shall be of constantly reducing cross-sectional area in the direction of flow. There shall be no parallel section in the liquid flow path between the liquid duct and the exit orifice of the liquid nozzle. The distance between the exit orifice of the inner nozzle and the exit orifice of the outer nozzle shall be such that substantial air entrapment by the liquid stream occurs prior to its discharge from the outer nozzle.

H. The outer exit orifice shall have a cross-sectional area of at least 2.5 times that of the inner nozzle exit orifice. The outer nozzle shall be of constantly reducing cross-sectional area in the direction of flow with an included angle of at least 20° for at least nine inches along the flow path to increase the velocity of the air/liquid stream.

I. Both inner and outer nozzles shall be of a non-clog design, free from all protrusions which might collect stringy material, and be capable of passing a 2 1/8” spherical solid. Inner and outer nozzles shall be fabricated of isophthalic, corrosion resistant laminating resin, reinforced with glass fibers, and a surfacing material of a commercial grade chemical-resistant glass having a coupling agent. The interior of each air and liquid nozzle shall contain a “co-abrasion” liner to specifically achieve optimum chemical and abrasion

resistance. Each nozzle shall contain a specific liner separate from the structural fiberglass wall of the nozzle. The liner shall be constructed of a glass laminate utilizing a minimum of 2 layers of 0.010 inch synthetic, apertured "Nexus" or "C glass" veil. The interior liner shall be a resin-rich surface layer containing no more than 20% by weight of either synthetic or "C-glass" veil and shall be free from cracks and crazing. Exterior of outer nozzles shall be protected with a separately cured, pigmented, pariffinated gel coat to protect from UV degradation. All construction shall be in accordance with the American Voluntary Standard PS 15-69, or the Canadian Voluntary Standard 41 GP-92.

J. The air manifolds shall be enclosed conduits which convey the compressed air from the air duct to the jet aerator assembly. The air manifolds shall be fabricated of an isophthalic, corrosion resistant laminating resin, reinforced with glass fibers, and a surfacing material of a commercial grade chemical-resistant glass having a coupling agent. Air manifolds shall be fabricated in accordance with NBS Specification PS 15-69.

2.3 FLUSH OUT SYSTEM

A. A positive pneumatic system shall be provided. The aeration system manufacturer shall provide all necessary piping, valves, and supports for the flush-out system. Flush out system shall be coordinated by contractor so that it operates with the supplied project aeration blowers and air header supply system. Along with the riser pipe and fittings, the flush-out system shall include at least two (2) riser supports, and a valve support/mounting bracket. It is the responsibility of the manufacturer to include all required pipe and fittings necessary to locate the valve where it is easily accessible and operable. Flush-out valve shall be a manual plug valve.

2.4 AIR PIPING

A. All in-basin air piping shall be provided as a part of the aeration system. The piping shall be of adequate length and diameter to transport the compressed air from a point immediately above the aeration header at the top of the basin wall, as shown on the plans, to the air duct of the aeration header. Hardware required to complete this flanged interface connection will be supplied by the contractor. In-basin air piping shall be machine filament wound, fiberglass reinforced thermosetting resin pipe fabricated in strict accordance with ASTM Specification D-2996-01.

2.5 LIQUID PIPING

A. All in-basin liquid piping shall be provided as a part of the aeration system. The piping shall be of adequate length and diameter to transport the motive liquid from the pump discharge connection, as shown on the plans, to the aeration header. A flanged connection shall be provided at this interface point, and hardware to complete this flanged connection shall be supplied by the manufacturer. In-basin liquid piping shall be machine filament wound, fiberglass reinforced thermosetting resin pipe fabricated in strict accordance with ASTM Specification D-2996-01.

2.6 SUPPORTS

A. All in-basin liquid piping shall be provided as a part of the aeration system. The piping shall be of adequate length and diameter to transport the motive liquid from the pump discharge connection, as shown on the plans, to the aeration header. A flanged connection shall be provided at this interface point, and hardware to complete this flanged connection shall be supplied by the manufacturer. In-basin liquid piping shall be machine filament wound, fiberglass reinforced thermosetting resin pipe fabricated in strict accordance with ASTM Specification D-2996-01.

2.7 MOTIVE LIQUID PUMPS

A. See specification Section 11319 Submersible Pumps for requirements of pump to be supplied as part of Jet Aeration System.

2.8 AERATION BLOWERS

A. Aeration blower are specified in Specification 11380. Air supplied by the blowers will be utilized by the Jet Aeration System, but are not a part of the Jet Aeration System package.

2.9 ANCHOR BOLTS

A. Anchor bolts of sufficient size and quantity shall be provided for mounting of all manufacturer supplied SBR equipment and piping in the basin. The anchor bolts shall be two-part stud and acrylic resin system. The anchor system shall consist of acrylic resin and hardener contained in a dual cartridge with static dispensing nozzle. Each anchor bolt shall be supplied with a stud, flatwasher, lockwasher and nut of Type 18-8 stainless steel.

2.10 FIELD SERVICE

A. The Jet Aeration System manufacturer shall provide an installation dry check consisting of one trip of one man-days, and start-up, operator instruction and training service consisting of one trip for a minimum of one man-days. All service shall be carried out by a qualified service technician. Written service reports of each service phase shall be distributed to the Engineer and Owner.

2.11 ACCEPTABLE MANUFACTURERS

A. Provide nozzle mixing system equipment from one of the following acceptable manufacturers:

1. Evoqua Vari-Cant Jet Aeration System
2. Mass Transfer Systems
3. Parkson VariOx
4. Approved equal

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01600, Materials and Equipment.

2.12 QUALITY ASSURANCE

A. The pumps, motors, and nozzles shall be a product of manufacturers that have been regularly engaged in the manufacturing of equipment having similar service and capacity for the last 15 years minimum.

B. Manufacturers shall provide evidence of at least five (5) installations in which similarly sized equipment in similar applications has provided satisfactory performance for a minimum of five (5) years in a similar application.

C. Listing of a manufacturer above does not imply that its standard product is acceptable. The successful manufacturer will be required to conform to the specifications.

2.13 SPARE PARTS

A. Provide spare parts in accordance with requirements of Section 01700, Contract Closeout.

B. At a minimum, provide manufacturer's recommended spare parts for 2 years of operation.

PART 3 - E X E C U T I O N

3.1 DELIVERY, STORAGE AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600, Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All complete aeration system units (this includes pump, motor and drive) will be tested on water as a complete unit at the manufacturer's plant before shipment. The testing shall be a complete non-witnessed performance test and is to include head and capacity, brake horsepower, and oxygen transfer efficiency to different depths, pump flow rates, and air flow rates to provide transfer efficiency curves for the aeration system under various operational conditions.

B. Certification of all factory testing data and results, including certified pump curves, shall be submitted for Owner's Representative review.

3.3 INSTALLATION

A. Install all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.4 SERVICES OF MANUFACTURER

A. Furnish the services of a representative of the Jet Aeration System manufacturer to assist Contractor during installation and in adjusting and mechanical testing of the equipment furnished, to supervise the initial operation, and to make any final adjustments as necessary to assure the Owner that the pumps are in satisfactory operating condition. The Jet Aeration System manufacturer shall provide an installation dry check consisting of one trip of one man-days,

B. Furnish sufficient supervision, data, and information from each manufacturer to train operators in the proper operation and maintenance of the pump(s) furnished

3.5 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by the both the manufacturer's factory representative and the Owner's Representative.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Owner's Representative. Written service reports of each service phase shall be distributed to the Engineer and Owner.

C.

3.6 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655, Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

END OF SECTION

SECTION 11220

FLOATING SUPERNATANT DECANTER

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of one (1) floating supernatant decanter. This unit is to be completed in place, installed in the sludge holding tank structure, as indicated on the drawings. The decanter shall include a withdrawal manifold with orifices, a floatation device, and all auxiliary equipment and appurtenances required for a complete and operational system.

B. This requirement may include equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be accepted by the Engineer.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300, Submittals, and Section 01340, Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Engineer review.

C. Shop Drawings/Product Data. At a minimum, provide the following:
   1. Provide complete descriptive product data, detailed installation drawings, accessories and related information.
   2. Any exceptions to the specifications.

D. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730, Operation and Maintenance Data.

E. Submit operating data to show compliance with removal efficiencies specified.

F. Provide a letter of certification signed by an authorized representative of the manufacturer stating that the manufacturer has inspected the installation and verified training of the Owner's operations and maintenance personnel upon completion of the installation. The certification shall state that the equipment has been installed in accordance with the manufacturer's recommendations, is in proper adjustment and operating condition, the manufacturer is prepared to warrant the equipment to perform in full compliance with these specifications, and the equipment is ready to be turned over to the Owner for operation.

1.3 WARRANTY

Provide equipment warranty, a minimum 2 years in duration from final completion, in accordance with the requirements of Section 01700, Contract Closeout.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. Decanter shall be designed based on the following conditions:

Item	Description
Quantity	1
Design Flow (gpm)	300

2.2 ACCEPTABLE MANUFACTURERS

A. Provide equipment from the following acceptable manufacturer:
1. Evoqua
2. or Owner approved substitution.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01600, Materials and Equipment.

2.3 QUALITY ASSURANCE

A. All equipment items furnished under this specification shall be furnished by a single supplier who shall be responsible for the adequacy of design.

B. Equipment shall be supplied by a firm that has regularly engaged in the design, fabrication, assembly, testing, start-up and service of grit chambers, as proposed for use in wastewater treatment for a minimum of five (5) years. The manufacturer must have installed and had in satisfactory use a minimum of five (5) installations of similar type, comparable size or larger, and of the approximate capacity as given to the units specified. Submit list with contacts to engineer for review.

C. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume responsibility for the proper function of all equipment, following installation.

2.4 PRODUCT DESCRIPTION

A. Piping. Each orifice shall allow equal flow into the draw tube. The draw tube, containing the orifices for removal of supernatant shall be integrally attached to the foam filled float such that the float remains level throughout the full range of operation, and to maintain submergence of the orifices of the main body. The main body will be connected to the effluent piping by means of a 4" flanged stub. The effluent pipe shall include a "knee" joint to allow vertical movement. The "knee" joint shall be wire reinforced rubber hose with a flange at each end, and include a support mechanism that allows vertical articulation, but precludes lateral or twisting movement. Hose shall be suitable for abrasive materials, and shall be rated at 30 inches mercury vacuum and 15 PSI working pressure. The effluent pipe shall be provided with a flanged connection for mounting the decanter system to the installed pipe through the basin wall. Flange connection shall be in accordance with ANSI standard 150-pound bolt pattern. Hardware at this flanged connection interface shall be furnished by the contractor.

B. Supports. All necessary supports for the decanter mechanism shall be provided. The supports will be located on the basin floor, and will support the decanter mechanism when the basin is dewatered. The supports shall be fabricated 304 stainless steel for corrosion resistance. The supports shall consist of a support plate welded to a supporting base. The base shall be anchored with anchor bolts and grouted in place, if necessary. Fastening hardware shall be Type 18-8 stainless steel.

C. Spare Parts. Provide spare parts in accordance with requirements of Section 01700, Contract Closeout.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600, Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 INSTALLATION

A. Install all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.3 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, and approved by the manufacturer's factory representative and subject to review by the Owner's Representative.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Contractor shall submit written certification from Manufacturer's factory representative of proper equipment installation and operation to Owner and Owner's Representative.

3.4 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655, Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

END OF SECTION

SECTION 11225

CLARIFIER MECHANISMS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of all supervision, labor, materials, tools, equipment and related items to furnish, install and place in operation two (2) 30-foot diameter, bridge mounted secondary clarifiers CL-401 and CL-402 of the scraper plow collector type, as shown on the drawings and described herein.

1.2 SUBMITTALS

A. Provide submittals in accordance with the Section 01300 – Submittals. Provide complete descriptive data and fabrication and installation drawings, including but not limited to structural calculations, product data, drive AGMA compliance, controls, accessories and related information.

B. Shop Drawings. Submit shop drawings and product data as specified in Section 01300 - Submittals. This will include, but is not limited to, product data for motors.

C. Manufacturer's Report. Upon completion of installation, a service engineer employed by the manufacturer will provide the Owner with a written report of start-up, set points and calibrations. Final settings will be reviewed. Submit in accordance with the requirements in Section 01655 – Starting of Systems.

D. Design Certification. The manufacturer shall submit a written report, signed and sealed by registered Professional Engineer, certifying that all drives and other designs, such as structural, have been performed using sound engineering judgment and according to good engineering practice.

1.3 WARANTY

Clarifier Mechanism shall be warranted as specified in Section 01700 – Contract Closeout.

1.4 REFERENCE STANDARDS

A. ASTM A-36 American Society of Testing Materials – Structural Steel Specifications

B. ASTM A-325 American Society of Testing Materials – Fastener Specifications

C. ASTM F593 American Society of Testing Materials – Bolt Specifications

D. ASTM A-48 American Society of Testing Materials – Cast Iron Specifications

E. ASTM A-536 American Society of Testing Materials – Cast Iron Specifications

F. AISI 4142 American Iron and Steel Institute – Heat Treated Steel Specifications

G. AGMA American Gear Manufacturers' Association – Gear Ratings

H. AWS American Welding Society - Current Standards

I. AFBMA Anti-friction Bearing Manufacturers' Association – Bearing Life Specifications

J. ASTM A283C American Society of Testing Materials – Steel Plate Specifications

K. NEMA National Electrical Manufacturer's Association – Motor Design Standards and Standards for Control Enclosures

1.5 OPERATION AND MAINTENANCE

A. Operation and Maintenance Manuals. Provide operation and maintenance manuals in accordance with provisions of Section 01300 – Submittals, Section 01661- Instruction of Operation and Maintenance Personnel, and section 01730 – Operations and Maintenance Data.

1.6 STORAGE

Store the equipment and accessories on-site prior to installation in accordance with the manufacturer's recommendations and the requirements of Section 01600 – Materials and Equipment. Provide the Owner's Representative with the supplier's recommended storage instructions.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. Design Parameters.

a. See the attached Clarifier Data Sheet for Clarifier Design Parameters

b. Clarifier Launder: Launder trough depth - 12 in. minimum *

* Information to be confirmed by manufacturer.

2.2 Acceptable Manufacturers

A. Provide equipment from one of the following acceptable manufacturers.

1. McNish - Walker Process Equipment.
2. WesTech Engineering, Inc.
3. Ovivo
4. Evoqua

2.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications. The scraper plow collector type secondary clarifiers to be furnished under this section of the specifications shall be manufactured by an equipment manufacturer who has furnished similar scraper plow clarifiers of the same design in a similar size or larger for a minimum of ten (10) installations.

2.4 PRODUCT DESCRIPTION

A. Components.

1. Provide two (2) scraper plow collector type secondary clarifier components for installation in two (2) concrete settling tanks, 30-foot diameter having 14-foot side water depth, 2-foot of freeboard. The tank floor shall have a 1-inch:12-inch slope. Each clarifier shall include the following:

a. Drive assembly, complete with necessary primary and secondary gear reduction units, motor, and overload protection.

b. Sludge removal truss arms with scrapers which move sludge toward a central sludge collection hopper.

c. Influent feed well and supports.

d. Energy dissipating inlet.

e. Bridge and walkway.

f. Surface skimmer, scum box, anti-rotation baffle, flush valve assembly.

g. Anchor bolts and attachments.

h. Effluent trough (launder), weirs, scum baffles, and eddy current baffle (Stamford baffle), in accordance with the manufacturer's recommendations and the requirements of Section 11281 – Weirs and Baffles.

B. Operation.

1. Scraper Plow Collector Type Clarifiers

a. The sludge collector mechanism shall utilize a center drive mounted from the bridge. The center drive shall support and rotate the two sludge rake arms, and the feedwell. The sludge rake arms shall be stainless-steel truss construction with stainless-steel scraper blades and adjustable stainless-steel squeegees. These scraper blades shall convey settled sludge to a central sludge withdrawal hopper. The rake speed shall be sufficient to transport the necessary volume of sludge to the sludge outlet, but shall not resuspend settled solids.

2.5 DRIVE ASSEMBLY

A. General Description. The drive mechanism shall be completely factory assembled and shall consist of a solid or split internal main gear, turntable, pinion, secondary speed reducer, support base, drive unit bearing, and an overload protection device. The drive shall be mounted from the bridge and support the entire rotating load of the mechanism.

B. Design Parameters.

1. Clarifiers

a. The clarifier drive unit shall be designed for the running torque value specified and confirmed by manufacturer. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L-10 life of 50 years. The drive gear shall be designed to a minimum AGMA 5 rating when rated in accordance with AGMA 2001-C95.

b. All gearing shall be designed per AGMA standard 2001-C95 for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the two values determined from the above AGMA standard.

c. The main internal gear shall be forged of alloy hardened steel or ASTM A 536 grade 80-55-06 ductile iron. The pinion shall be heat treated alloy steel. All speed reducers shall be fully enclosed and running in grease or oil. The support base for the drive shall be of welded steel or ASTM A 48 Class 40 cast iron to assure rigidity. Oil and dust shields shall be provided.

d. The drive bearing shall include a forged steel precision gear/bearing set, with fully contoured raceways hardened to a minimum 58-60 Rc or bearing balls with 4140 strip linears heat treated to minimum hardness of 43-46 Rockwell. The drive shall be designed so that the balls can be easily replaced independent of the main gear and without removing the access walkway.

e. The main gear and pinion shall be oil lubricated. Lubrication fittings shall be readily accessible from the access bridge. Gear and bearing housings must be fitted with oil level sight glasses. Condensate drains shall be provided in the main gear housing.

f. The center drive shall be provided with connections for the two (2) sludge removal arms and feedwell supports. The drive shall rotate the attached arms and feedwell. The minimum angle size used for construction of the rake arms shall be 2-inch x 2 inch x 1/4 inch members.

g. Speed Reducing Unit.

1) The primary gear reducer shall be of either worm/worm gear, planetary, helical or cycloidal design and shall be C-face or integrally mounted to the electric motor.

2) The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloidal disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft.

3) The speed reducer helical gearing shall be manufactured to AGMA standards. The speed reducer shall have a service factor of 1.40 (AGMA Class II)

4) The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and run in a totally submerged oil bath or be grease lubricated.

2. Overload Protection.

a. The drive unit shall be equipped with an electro-mechanical overload control device actuated by thrust from the worm shaft. The pointer shall provide a visual reading of the relative main gear output torque on a 0 to 100 percent graduated scale readable from walkway. The 100 percent reading shall equal the 100 percent drive rating. The control device shall also activate an alarm switch for warning of impending overload, a motor cutout switch for overload protection and a back-up safety motor cutout switch for back up overload protection. . The respective switches in the overload control device shall be factory calibrated and set to the following settings:

1) Alarm - 40% of scale.

2) Motor cutout - 85% of scale.

3) Back-up motor cutout or slip clutch - 100% of scale.

b. All drive control components shall be mounted in a waterproof enclosure of epoxy coated aluminum or stainless steel with a gasket sealed, removable cover. The pointer shall be covered with a clear plastic enclosure and shall be above the platform surface for visibility from the platform. Amperage sensing devices, devices with exposed linkage connections, or devices which react to rotational movement of an intermediate reduction unit are not acceptable.

3. Motor.

a. The motor shall be TEFC, "Severe Duty Classification for Hostile Environments," 1.15 service factor, NEMA Design B in accordance with Section 16222 – AC Electric Motors 100 HP and Below. The motor shall be designed for continuous operation in humid outdoor conditions. The power supply to the equipment shall be 460 Volt, 3 phase, 60 hertz.

b. Contractor shall provide an elapsed run time meter for the motor. The elapsed run time meter shall be 6-digit, non-resettable and sealed against dirt and moisture, 120 VAC, with indication of motor run time in hours with 1/10 hour increments.

2.6 CENTER DRIVE, INFLUENT WELL AND BRIDGE

A. Structural Members.

1. Structural steel shall conform to AISI 316/316L dual certified. Steel pipe used for structural members shall conform to ASTM A312. All steel parts which are continuously or intermittently in contact with liquids shall have a minimum thickness of 1/4 inch. Connections shall be shop welded or field bolted. Field welding will not be permitted, except for the bridge splice.

2. All structural members shall be designed such that the stresses on the net section and the overall deflection of any member shall not exceed the allowable stresses and deflection as listed under AISC specifications for "Design, Fabrication, and Erection of Structural Steel for Buildings." The stress and deflection calculations for these members shall be based on the uniform distribution of the AGMA rated torque of the drive mechanism applied at the panel points of one support truss. The equipment manufacturer shall submit a written report, by a registered Professional Engineer, certifying that all stress and deflection calculations (with input data and shop drawings) have been performed using sound engineering judgment and according to good engineering practice.

3. Fabricated assemblies shall be shipped in the largest sections permitted by carrier regulations, properly match-marked for ease of erection.

B. Welding.

1. The equipment manufacturer's shop welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1, Welding in Building Construction, of the American Welding Society.

2. The equipment manufacturer's shop drawings shall clearly show complete information regarding location, type, size and length of all welds in accordance with Standard Welding Symbols, AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes or details.

3. The Contractor's welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1, Welding in Building Construction, of the American Welding Society.

C. Center Drive Platform.

1. A center drive platform shall be provided which allows a minimum of 24-inch clearance outside the center drive components. It shall consist of 1/4-inch aluminum nonskid checkered plate with necessary stiffeners and supports, and be connected to the walkway by means that ensure dielectric isolation. The entire platform shall be surrounded by handrails 42 inches high of double-row 1-1/2 inch diameter horizontal aluminum pipe with 1/4" x 4" high kickplates. The center drive platform shall be 8-feet by 8-feet minimum.

D. Energy Dissipating Inlet.

1. For the clarifier: a circular energy dissipating inlet with bottom shall be supported by the cage and be designed to diffuse the liquid into the feedwell in a tangential direction without excessive disturbance or formation of vertical velocity gradients. Alternately, a flocculating Energy Dissipating well shall be acceptable.

E. Influent Feedwell.

1. The influent feedwell shall be fabricated of 3/16-inch stainless steel plate sections with bolted connections and 1/4-inch structural stainless steel trim angles top and bottom for shape and rigidity. The well shall diffuse the flow into the tank at a uniform flow-through velocity (well dimension shall be, at minimum, 32-foot diameter by 8-foot depth). Ports shall be cut into the influent well to permit the escape of entrapped scum for the clarifier. Ports shall be baffled to prevent short circuiting to the effluent weir. The feedwell shall be supported from the center cage or from the bridge.

F. Rake Arms.

1. Each arm shall be designed to withstand 150 percent of the design running torque of the drive without over-stressing the members. Loading to develop the torque shall be considered as uniform loads applied to each arm individually.

G. Bridge.

1. An all-welded structural stainless steel access bridge, of truss or beam construction, shall extend beyond the clarifier and provide a bridge to the outer aeration basin tank walls and support the center drive. The bridge shall include a center drive platform and be designed to support, in addition to the dead load, a live load of 50 pounds per square foot, with a deflection not exceeding 1/360 of the span. A 3-foot-wide walkway, with 1-1/4″ x 3/16″ aluminum grating between the beams, shall be provided.

2. The walkway shall be diagonally braced against lateral movement, and provided with handrails 42″ high, of double-row 1-1/2″ diameter horizontal aluminum pipe, and 1/4″ x 4″ high kickplates on both sides. Walkway trusses may serve as handrailing if the top chord is 3′-6‴ above the walking surface. Use isolation kits for handrail when connecting dissimilar metals.

2.7 SLUDGE REMOVAL SYSTEM

A. Scraper Plow Collector Type Clarifiers

1. Sludge Rake Arms and Scraper Blades.

a. The mechanism shall include two sludge rake arms of stainless steel truss construction with stainless steel scraper blades and adjustable stainless steel squeegees. Squeegees shall be fastened to the rake blades with stainless steel fasteners.

b. Scraper blades shall be designed for sufficient sludge transport capacity to handle the design solids loading rate, with the depth of the blade varying from a minimum at the tank periphery to a maximum at the tank center.

c. Blades shall be properly sized to ensure complete raking of the bottom twice per revolution and to convey settled sludge to the sludge withdrawal hopper. Blades which move sludge away from the center column to the top of the sludge withdrawal hopper shall also be provided.

d. The rake speed shall be sufficient to transport the necessary volume of sludge to the sludge outlet, but shall not re-suspend settled sludge.

2.8 CLARIFIER SKIMMER/SCUM BOX

A. General Description. A "full surface" skimmer shall be furnished consisting of a stationary scum baffle, rotating scum blade and skimming assembly, and scum box. The rotating scum skimmer shall include a vertical stainless steel plate skimmer blade supported by vertical stainless steel members extending up from the rake arms. The blade shall extend tangentially from the influent feedwell to the hinged scum skimmer assembly at the tank periphery.

B. Stationary Scum Baffle. The stationary scum baffle shall be designed to trap scum as the scum blade rotates and direct the trapped scum out toward the scum box. The scum baffle shall consist of 15" deep fiberglass sections with support brackets as described in Section 11281 – Weirs and Baffles. The baffle sections shall be curved and fastened to the launder wall with adjustable support brackets, stainless steel fasteners, and anchor bolts.

C. Scum Skimmer Assembly. A hinged scum skimmer assembly shall be mounted on the outer end of the skimmer device. The hinged scum skimmer assembly shall be designed to form a pocket for trapping the scum. The hinged arrangement shall ensure continual contact and proper alignment between wiper blade, scum baffle, and ramp as the blade travels up the ramp. The wiper blade shall have a wearing strip on its outer end which contacts the scum baffle and a neoprene strip on its lower and inner edge. The neoprene wipers shall be a minimum 1/4-inch thickness. The scum is trapped as the wiper blade meets the ramp and is raised up the ramp to be dumped into the scum box for disposal.

D. Scum Box. The scum box shall be 4 feet wide, supported from the tank wall and connected to the scum withdrawal piping. It shall be made of ¼ inch thick welded stainless-steel plate to serve as an integral section of the tank's scum baffle. The assembly shall have a scum trough, vertical steel sides, and a sloping ramp. A flexible connector shall be provided for connection to the scum withdrawal piping in the tank wall.

E. Scum Flushing System. Provide a 1 ½ ” nozzle, pipe and ball valve on the scum box side accessible from the walkway. The location shall be submerged and be operated manually on the secondary clarifiers. On the clarifiers, the valve shall actuate at every pass of the of the scum skimmer over the scum box allowing sufficient delay after the deposits of solids before flushing begins. Delay and flush duration shall be adjustable. The valve shall use mechanical or hydraulic means without the use of electrical or pneumatic motors or switches.

2.9 EFFLUENT REMOVAL

A. Launder.

1. A fiberglass rectangular effluent trough shall be provided around the perimeter of the tank as described in Section 11281 – Weirs and Baffles. A dropout box shall be provided integral to the trough at one point for collection and discharge of the clarified effluent.

B. Weir. An adjustable weir shall be provided around the periphery of the tank at the water surface for removal of clarified effluent. The weir shall consist of 12" deep fiberglass sections with 2 ½ -inch deep, 90-degree V-notches on 6-inch centers as described in Section 11281 – Weirs and Baffles.

2.10 APPURTENANCES

A. Anchorage. The equipment manufacturer shall furnish all anchor bolts, nuts and associated fasteners. These items shall be of Type 316 stainless steel construction with isolation kits. The manufacturer shall furnish anchor bolt templates and related instructions.

B. Painting. Protective finishes shall be of the type specified in Section 09928 – Protective Coatings for Wastewater Systems. Painting shall not be required for stainless-steel components.

C. Launder covers. Launder covers shall be provided as specified in Section 11280 – Launder Covers.

2.11 CONTROL PANEL

A. The manufacturer shall supply a local NEMA 4X type 316 stainless steel control panel, in accordance with Section 13413 – Control Panels, for the clarifier. Configure the control panel in accordance with any applicable control diagrams in the drawings.

B. Provide conduit and wiring between control panel, motors and all field devices in accordance with applicable sections of Division 16.

2.12 CLARIFIER OPERATION

A. Provide clarifier operation in accordance with Section 13405 – Control System Operation.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store and protect all equipment in accordance with the requirements of Section 01600 – Materials and Equipment.

B. Deliver, handle, store and protect all equipment in accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the component's complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Owner's Representative review.

3.3 CORROSION PROTECTION

A. Shop-prime all non-stainless steel metal surfaces to allow for protective coating by Contractor.

B. Provide isolation kits where dissimilar metals would otherwise be in direct contact leading to galvanic corrosion.

C. Contractor shall be responsible for coating metal surfaces with protective coating as specified in Section 09928 – Protective Coatings.

3.4 INSTALLATION

A. Installation of the clarifier mechanisms is a part of this contract. Assemble and install the clarifier mechanisms/sludge collectors in the proposed clarifier basins in accordance with the manufacturer's instructions.

B. Contractor shall be responsible for installing all components as shown in the plans and in accordance with the manufacturer's working drawings after the drawings have been reviewed by the Owner's Representative, and the manufacturer's standard installation requirements.

C. After the equipment is installed, the alignment and installation shall be checked and approved by the factory representative in the presence of the Owner's Representative. The installation shall be rechecked and approved by the factory representative in the presence of the Owner's Representative after alignment and bolt tightening is complete.

D. Grout all foundation bolts after approval of the installation by the Owner's Representative. Two (2) inches of bonded concrete topping shall be swept on the basin bottoms using the sludge collector. Such grouting shall be done in strict accordance with the manufacturer's instructions. Provide all necessary lubricants.

E. The Contractor shall be responsible for the installation and connection of all associated control wiring between the control panel, equipment and/or Owner-required monitoring locations.

3.5 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by both the manufacturer's factory representative and the Owner's representative. The equipment manufacturer shall provide a factory-trained representative to inspect the equipment installation, supervise mechanical adjustments, conduct start-up, and supervise torque testing of the equipment. The manufacturer will submit to the Owner's Representative a written

report certifying that the equipment has been satisfactorily installed, lubricated, and is ready for operation. The time and travel will be as required by the Contractor and will be in addition to the specified time for training of Owner's operating personnel.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Engineer.

C. Torque Tests.

1. The equipment supplier shall perform on site field torque tests on the units to verify the design of both the drives and the mechanism. Tests shall provide proof of running torque capability and shall also verify the operation of the warning and overload shutdown systems.

2. The entire sludge collector mechanisms shall be statically load tested by individually loading each clarifier arm with 150 percent of the specified design running torque. The test shall verify the torque overload control device settings for alarm and motor cutout. Each arm shall be individually anchored, and the load measured to demonstrate the arm's, cage's, and drive unit's ability to withstand the specified torque. Sketches and calculations shall be submitted illustrating how the torque will be applied prior to the test taking place.

D. Operational Test.

1. The mechanism shall be operated in a dry tank for a minimum of 6 continuous hours before flow is allowed to enter the system. There shall be no binding, jerky or unusual motion exhibited during this run-in period. Motor amperage shall be checked at least hourly for any unusual or higher than normal figures. After the unit has successfully passed this initial test, flow shall be introduced into the tank and the same 6-hour observation test run. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be replaced at no additional cost to the Owner, and the test rerun.

3.6 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655 - Starting Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

C. The equipment manufacturer shall provide a factory-trained representative to inspect the equipment installation, supervise mechanical adjustments, conduct start-up, and supervise torque testing of the equipment. The manufacturer will submit to the Owner's Representative a written report certifying that the equipment has been satisfactorily installed, lubricated, and is ready for operation. The time and travel will be as required by the Contractor and will be in addition to the specified time for training of Owner's operating personnel.

SECTION 11266

UV DISINFECTION SYSTEM

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of a low-pressure high output ultraviolet (UV) lamp system of a self-contained closed-channel gravity flow, horizontal lamp orientation type with transmissivity meter. The supplied system shall be complete and operational with all control equipment and accessories as shown on the drawings and specified herein.

1.2 SUBMITTALS

A. Submit complete descriptive data and fabrication and installation drawings, including but not limited to equipment provided by the UV System supplier, product data, electrical drawings, controls, accessories and related information.

B. Shop Drawings. Submit the following shop drawings and product data, as a minimum.

1. Layout, overall dimensions, required clearances and general description of the equipment, including location of electrical equipment, control panels and other auxiliary equipment.
2. Details of attaching equipment, services, auxiliary equipment, accessories, etc.
3. Complete data on materials to be used for fabrication.
4. Electrical control schematics, wiring diagrams, panel layout and general description including list of materials.
5. A report on headloss measurements conducted by an independent laboratory on a UV lamp system with lamp spacing by manufacturer which is the same as the system proposed in the bid.
6. Manufacturer's third-party bioassay report. Bioassay test procedure to meet the requirements specified in 30 TAC Chapter 217 Subchapter L § 217.296.
7. Operating characteristics of all electrical and control equipment; operating voltage and amperage tolerances; ancillary electrical services required.
8. List of which components and materials shall be shipped preassembled and parts list for the other components and materials. Weights and physical dimensions shall be indicated for each part, assembly and/or package to be shipped.

C. Manufacturer's Report. Upon completion of installation, a service engineer employed by the manufacturer will provide the Owner with a written report of start-up, set points and calibrations. Final settings will be reviewed.

D. UV System Sizing Calculations. The equipment manufacturer shall submit complete and detailed calculations used in sizing the UV disinfection system (number of lamps required). All factors, coefficients and constants selected or calculated shall be clearly stated and associated with the appropriate symbols. A clear and concise statement of the judgement exercised and the justification for said judgements in selecting all factors, coefficients and constants are considered a necessary part of the calculations submitted for review.

E. Operation and Maintenance Manuals. Provide operation and maintenance manuals in accordance with Section 01661 – Instruction of Operation and Maintenance Personnel and Section 01770 – Closeout Procedures. Include complete description of operation together with general arrangement and detailed drawings: wiring diagrams for power and control schematics, parts catalog with a complete list of repair and replacement parts with section drawings illustrating the connections and identifying numbers.

1.3 QUALITY ASSURANCE

The UV disinfection system shall be furnished by an equipment manufacturer who has furnished UV disinfection systems of the same design in a similar size or larger system for a minimum of five installations within the last 3 years.

1.4 DESIGN CRITERIA

A. Design Parameters. The UV disinfection system shall be designed to handle the following flows and wastewater parameters:

Phase I		
Average Daily flow rate (ADF)	.5/ 348	(MGD)/(GPM)
Peak 2 hr. Hydraulic flow rate	1.5/ 1,042.0	(MGD)/(GPM)
Phase II		
Average Daily flow rate (ADF)	1.0/ 694.5	(MGD)/(GPM)
Peak 2 hr. Hydraulic flow rate	3.0/ 2,083.0	(MGD)/(GPM)
Phase III		
Average Daily flow rate (ADF)	1.5/ 1,042.0	(MGD)/(GPM)
Peak 2 hr. Hydraulic flow rate	4.5/ 3,125.0	(MGD)/(GPM)
UV Transmittance	65.0	% UVT (Minimum)
Total Suspended Solids	15.0	mg/l (daily average)
BOD (5-day)	10.0	mg/l (daily average)
Target Indicator Organism	Enterococci	
Permit Criteria (maximum)	104.0*	CFU/100 ml, single sample max
Permit Criteria (GEOMEAN)	35.0*	CFU/100 monthly GEOMEAN
Disinfection MS-2 UV Dose	45.0*	Minimum Validated MS-2 UV Dose of 45.0 mJ/cm^2. Calculated per independent third-party bioassay validation performed in accordance with NWRI 2012 guidelines, after application of a third party certified EOLL of .87, and FF of .89.
Maximum Log Inactivation of Enterococci (Design)	4 Log Inactivation of Enterococci.	
Plant Process	CAS including, preliminary fine screening 0.1-inch drum and grit removal; secondary treatment including activated sludge (biological ammonia removal through nitrification de-nitrification), and cloth media filtration prior to UV disinfection	
Particle Size	10	Microns
Total Iron	0.3	mg/l
NTU	2.0	NTU
Equipment Redundancy**	100.0	% of banks at average daily flow rate. No redundancy at peak 2 Hr. flow rate

*Effluent disinfection performance will be guaranteed.

**Minimum of two banks in series.

B. Performance Requirements.

1. The end-of-lamp-life UV dose produced by the system shall not be less than 45.0 mJ/cm^2, after 16,000 hours of lamp operation, to be measured in an effluent with a 65 percent UV transmission at 254 nm. Lamp output to be at 90 percent of its initial level after 12,000 hours of operation and with 95 percent fouling on the lamp sleeves or. The basis for evaluating the UV dose delivered by the UV system will be the manufacturer's bioassay as carried out by an independent third party.
2. Flange to Flange Head loss through the reactor shall be as follows:

a. Head loss through UV reactor/ Train < 1" at peak design flow rate of 0.5 MGD/UV Train
< 7.6" at peak hydraulic flow rate of 1.5 MGD/UV Train

3. The system will be able to continue providing disinfection while replacing UV lamps, quartz sleeves, ballasts and while cleaning the UV lamp sleeves.
4. The system will be designed for complete outdoor installation and service.

1.5 STORAGE

Store the equipment and accessories on-site prior to installation in accordance with the manufacturer's recommendations.

1.6 SPARE PARTS

At a minimum, furnish the following spare parts:

A. 5% of total system lamps.

B. 2% of total system electronic ballasts with plug-in connectors

C. 5% of total system fluropolymer tubes.

D. 5% of total system tube end seals.

E. One UV intensity sensor.

F. Two Operator's safety kit includes UV resistant Gloves, and Face Shields that block UV light wavelengths between 200 and 400 nm.

G. Two AFP Tube Cleaning Kits – Teflon brush and extension kit with adaptable poles.

1.7 WARRANTY

A. UV manufacturer shall warrant the UV system (UV modules, system control center, detection system, power distribution center, automatic level controller, support racks, electronics) for a period of 2 years under normal use, operation, and service.

B. UV lamps shall be warranted for a period of 16,000 hours of lamp operation (each individual lamp) during which time lamp output shall be a minimum of 90 percent of the original output.

PART 2 - P R O D U C T S

2.1 MANUFACTURER

The approved manufacturer for the horizontal lamp system is Enaqua.

2.2 GENERAL DESCRIPTION UV SYSTEM

A. The UV disinfection system shall reduce the concentration of viable microorganisms in the treatment plant effluent by irradiation with UV light at 254 nm.

B. Provide a UV disinfection system complete with UV modules, system control center(s), detection system(s), power distribution center(s), support rack(s), automatic level controller (finger weirs), spare parts and other equipment as required for the complete installation and operation of the system.

C. The disinfection system shall be able to continuously provide required disinfection dosage, based on peak design flow.

D. The UV System shall be able to either turn lamps off or dim lamps based on flow into each channel.

E. The UV disinfection system supplied shall be CSA or UL approved.

2.3 CONSTRUCTION AND MATERIALS

A. All metal components in contact with effluent shall be Type 316 stainless steel.

B. All wiring exposed to UV light shall be Teflon coated.

C. All material exposed to UV light shall be Type 316 or 304 stainless steel, quartz, Teflon or other UV resistant material.

2.4 HORIZONTAL LAMP UV SYSTEM

A. General

1. All module welded metal components in contact with effluent shall be Type 316l stainless steel.
2. All non-wetted metal components shall be Type 304 stainless steel with the exception of the Lamp Rack Assembly, which shall be constructed of aluminum and be capable of sustaining intermittent pedestrian traffic on the lamp racks.
3. All wiring exposed to UV light within the UV reactor, or electrical ballast enclosure shall be Teflon™ coated.
4. All wires connecting the lamps to the ballasts shall be enclosed inside the frame of lamp rack and not exposed to the effluent.
5. The effluent water shall be conveyed through the UV reactor via AFP_{840}™ tubes – there shall be no contact with effluent and quartz sleeves at any time during normal operation.
6. All wetted components in the UV reactor shall be: AFP_{840}™, 316l, PVC, ABS or other non-reactive, non-corrosive material.
7. The UV system (ballasts, lamps, and controls) shall be capable of 24 on/off cycles per 24-hour day for the full specified warranty life of the lamps and ballasts.

B. Lamp Array Configuration:

1. The lamp array configuration shall be the uniform array with all lamps parallel to each other and to the flow.
2. The UV reactor shall be designed to avoid any immersion of UV lamps in the Effluent.

C. Inlet/Outlet Flow Distribution:

1. Each UV reactor shall have an inlet and outlet tank. Plant effluent piping shall connect to each of the tanks to convey effluent through the UV reactor.
2. Connection to inlet and outlet tanks of UV reactor:
   Diameter: 12.00" Diameter (ASME/ANSI B16.5, CL 150 Flange)
3. Each UV reactor shall have a flow distribution sheet, so as to distribute wastewater efficiently through the AFP tubes.
4. The tanks and inlet flow distribution sheet shall be made of 304SS material. All material which comes in contact with the wastewater shall be non-corrosive.

D. Effluent Level Control Mechanism:

1. UV reactor shall have effluent level control mechanism (a rectangular contracted Weir plate, or V-Notch) installed in the effluent tank of the UV reactor ,provided by manufacturer. The weir geometry shall be designed such that the weir will flood varying # of AFP tubes based on flow thus achieving the required minimum submergence of the calculated # of AFP tubes and providing the minimum specified UV dose at varying flow conditions.
2. The effluent level control shall be a removable weir plate, and a weir frame installed in the effluent tank of the UV reactor. The weir plates and all mounting hardware shall be of 304 SS, to be supplied and installed by manufacturer.

E. AFP Tube Ultraviolet reactor:

1. Within the ultraviolet reactor, AFP tube UV transmitting tubes are arranged in a horizontal and vertical array. These AFP tubes are in a parallel mode and are attached at one end to the inlet flow distributor sheet and to the outlet flow distributor sheet with appropriate leak proof fittings. The AFP tubes shall be adequately supported.
2. In between and around the AFP tube tubes, lamp rack assemblies shall be placed in such a fashion so as to provide uniform and adequate ultraviolet light intensity. The lamp racks slide in and out between and around a row of AFP tube array.
3. Within the AFP tube UV reactor, all UV sensitive materials shall be protected from the UV light.
4. The flow path through the AFP tube tubes shall achieve optimized plug flow regime. The flow of wastewater should be in sufficient turbulent mode; therefore, the Reynold's number in each UV reactor would be greater than 50,000 at peak flow. A turbulent flow shall be in such a way that it scours the inner

walls of the AFP tube to help prevent scaling or fouling.

5. The UV reactor shall be covered from five sides with either coated aluminum or stainless panels. The sixth side (top) shall have access door(s). The lamp racks shall be accessible through these doors.
6. The air temperature inside the AFP UV reactor shall be maintained between 90-120 deg. F by means of an air-air heat exchanger to minimize the potential for increase in the temperature of the disinfected effluent. The control of the reactor temperature shall ensure optimum UV light emissions from the UV lamp.
7. A temperature sensor shall be installed within the UV reactor for protection against heat build-up under no or low flow conditions.

F. UV Reactor Thermal Control Mechanism:

1. Cooling within the UV reactor shall utilize a series of air to air heat exchangers. A series a cooling fans shall expel heat from the interior of the UV reactor to maintain the ideal temperature of the UV Lamps.
2. The UV equipment manufacturer shall supply the heat exchangers and associated controls.

G. UV Lamps: The UV lamps shall have the following characteristics:

1. A low pressure, high output (LPHO) non-amalgam mercury vapor lamp of the hot cathode type.
2. The filament shall be of the clamped design, significantly rugged to withstand shock and vibration.
3. Each lamp will produce at least 90% emissions at the germicidal frequency of 253.7 (254nm) nanometers.
4. The power consumption shall be a maximum of 138 input watts per lamp, total including ballasts losses shall not exceed 145 watts including ballast losses.

   The rated UV output at 253.7 nanometers (nm) shall be a nominal 57 UVC Watts at 100 hours of operation.

5. The lamp shall have a minimum UV intensity of >400 microwatts/cm^2 at 1 meter.
6. Each lamp shall have a rated life of 12,000 hours.
7. Each lamp shall be single ended. Each lamp shall have a nominal arc length of 1400 millimeters.
8. Each lamp has a minimum length of 1554 mm.
9. Each lamp shall produce no measurable amount of ozone.
10. Each lamp envelope is made of fused quartz and is capable of transmitting at 90% of UV light at 253.7 nm.
11. Electrical connections shall be at one end of the lamp and have six (6) pins, dielectrically tested for 2,500 volts. Lamps that have 2-4 pins (instant start) may be considered. However, to be considered as an alternate, instant start lamp systems shall supply replacement spare lamps equal to 20% of the total number of lamps in the system.
12. Each UV lamp shall have a smart lamp Module (an integral unique lamp identification chip) embedded in the lamp pin connector that enables the lamp position in the UV reactor to be altered independent of a lamp holder. The smart lamp module shall be capable of measuring and storing at a minimum the following data for each UV lamp in a reactor:
    a. Part and Serial number (unique identification) of each individual UV lamp
    b. Total accrued run time hours
    c. Lamp ON/OFF cycles

H. UV Lamp Racks

1. The UV lamp racks shall be placed between rows of the AFP_{840}™ tubes.
2. The lamp racks shall typically slide in and out within a track that shall be attached to the main frame of the UV reactor.
3. The use of cranes, hoists or other mechanical lifting devices shall not be required.
4. The lamp rack assemblies shall be made from aluminum.
5. Electrical mounting sockets shall be attached to one end of the lamp rack.
6. The other end of the rack shall have slotted holes to slide lamps in and out during installation and removal of lamps.
7. Reflectors optimized to reflect UVC wavelength of 253.7 nm, and improve UVC energy density within the UV reactor shall be arranged in between the UV lamps in the lamp racks such that each AFP840™ tube reactor has a minimum of six (6) UV lamps and four (4) reflectors surrounding it.

8. Quick power disconnects allow quick disconnect of the lamp rack assembly to the main power at the UV reactor chassis.
9. Each lamp rack shall be equipped with its own on/off switch and fuse.
10. Each lamp rack shall be equipped with an LED indicator to identify the operating condition of each lamp on the lamp rack.
11. Lamp Racks shall be removable for service during UV operation without impacting Hydraulic flow and still maintaining plug flow regime in the reactor.
12. Each lamp shall be controlled by an individual ballast. Systems that have one ballast controlling multiple lamps shall not be considered.
13. There shall be no quartz sleeves, O rings, seals, glands or retainers required to be around the lamps when installed in the lamp racks.

I. Electronic Ballasts:

1. The ballast used to energize the UV lamps shall be high frequency electronic ballasts. The ballasts shall be housed in the lamp rack assembly as an integral part of the lamp rack.
2. The electronic ballasts shall be rated at 120-277 V +/- 10% without discernible change of characteristics.
3. The electronics ballast shall have the following features:
   a. Power factor greater than or equal to 0.95.
   b. Electrical conversion efficiency greater than or equal to 90%.
   c. Ballast shall have high frequency phase returns from the UV lamps.
   d. The ballast operating frequency shall be between 40 and 150 K Hz.
   e. The ballast shall have a thermal overload protector to protect against overheating when ballast skin temperature reaches 75 deg. C.

J. UV Intensity Monitors

1. The UV reactor shall have a minimum of one UV intensity sensor per bank which responds to the germicidal portion of light generated. The sensor shall not degrade after prolonged exposure to the UV light or effluent.
2. The sensor shall measure only the germicidal portion of the light emitted by the UV lamps as measured at 254 nm. It shall have sensitivity at 254 nm of greater than 95%. Sensors whose sensitivity to other wavelengths amounts to more than 5% of the total sensitivity shall not be allowed.

K. Radar Level Sensor

1. 1. The inlet tank of each UV reactor shall include a radar level sensor and transmitter provided by Manufacturer of the non-contact UV disinfection equipment, which will monitor the water level in the inlet box and transmit a signal to the EDC for activation and de-activation of UV lamps based on the level in the influent tanks.
2. The radar level sensor/transmitter shall conform to the following requirements:

i.	Range:	Rod & coaxial: 9.8’ (3m) Cable: 18’ (5.5m)
ii.	Accuracy:	± 3mm
iii.	Dead band:	Top: 4” (10cm) Bottom: 2” (5cm)
iv.	Repeatability:	< 2mm
v.	Resolution:	< 2mm
vi.	Configuration:	WebCal® PC Windows® USB 2.0
vii.	Supply voltage:	10-30 VDC
viii.	Max. consumption:	< 50mA @ 24 VDC
ix.	Signal output:	4-20mA, 3-wire
x.	Signal fail-safe:	4mA, 20mA, 21mA, 22mA or hold last
xi.	Dielectric:	> 1.8
xii.	Process temp.:	F: -40º to 302º C: -40º to 150º
xiii.	Ambient temp.:	F: -40º to 185º C: -40º to 85º

xiv.	Pressure:	-14.5 to 250 PSI (-1 to 17 bar)
xv.	Enclosure rating:	NEMA 4
xvi.	Encl. material:	Aluminum
xvii.	Feed through mat.:	316L SS & PEEK
xviii.	Conduit entrance:	(1) 1/2" NPT connector
xix.	Probe material:	Rod: 316L SS Coaxial: 316L SS or galvanized Cable: 316 SS
xx.	Process mount:	3/4" NPT (3/4" G)
xxi.	Classification:	General purpose
xxii.	Certification:	cCSAus, NRTL
xxiii.	Compliance:	CE, CRN, RoHS

3. The radar level sensor/transmitters shall be Flowline EchoWave® LG10-11 Guided Wave Radar Level Transmitter or approved equal.
4. The radar level sensor/transmitter(s) shall be mounted atop the removeable lid of the inlet tank and extending to within one inch (1") of the bottom of the inlet tank.

L. Bypass UV Transmittance Sensor and Controller

1. If selected, one (1) bypass UVT% analyzer assembly shall be supplied by Enaqua and installed by contractor.
2. UVT Sensor shall be REALTECH REALUV M3000, with an automated pumping and cleaning system; REAL PUMP CLEAN SYSTEM I - or approved equal.
3. The tubing connecting the source of treated effluent to the REAL PUMP CLEAN SYSTEM I shall be translucent PE tubing .25" OD, connection between the REAL PUMP CLEAN SYSTEM I and the REALTECH REALUV M3000 shall be translucent PE tubing .25" OD, and discharge from the REALTECH REALUV M3000 to the building drain shall be translucent PE tubing .25" OD. Tubing, and all hardware necessary to route the tubing, and mount the enclosures shall be by contractor.

M. Electrical:

1. The UV reactor shall be powered from its own incoming power supply (to be supplied by others).
2. All cabling, conduit runs and wiring from the plant power supply to the UV reactor shall be as shown on the construction drawings.
3. The CONTRACTOR shall be responsible for bringing main and control power to the UV reactor through a Branch Circuit protections device (disconnect) as shown on the drawings.
4. Electrical power required shall consist of the following:

a.	Main power to reactor banks(s):	480 VAC, 3 phase, 4 Wire plus ground
b.	Cooling & Control power to reactor(s):	120VAC, 1 phase, 2 wire plus ground
c.	Power to UV Control Panel:	120VAC, 1 phase, 2 wire plus ground
d.	Power to UVT% analyzer:	120VAC, 1 phase, 2 wire plus ground

N. Power Panels:

1. The power panel(s) for the UV banks shall consist of a UL 508-A NEMA 4X type 314 SS rated electrical enclosures. The power panels shall house the following:
   a. All contactors, disconnects, terminations and fuses required to power the appropriate bank.
   b. Electrical safety lock-out.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install UV disinfection system in accordance with contract drawings, approved manufacturer's shop drawings and written instructions.

B. CONTRCTOR shall provide the following for installation:

1. Sufficient space for moving into place and placement of all equipment supplied by Manufacturer.
2. Equipment anchoring and grouting including anchor bolts.
3. All required permits.

4. Structural work such as concrete pads, mezzanines for elevating equipment items, etc.
5. Interconnecting electrical outside of the UV Skid limits including the incoming power supply, conduit and field terminations.
6. Connection and sealing of all flanges, fittings and connections to the adjacent plan processes.
7. All electrical outside the skid limits including, transformers and disconnect switches. Equipment electrical supply shall be detailed on the shop drawings.
8. Analytical testing.
9. Equipment unloading, moving and rigging into position.

B. The UV manufacturer shall furnish power and data cabling between the UV modules and the PDDC.

C. Furnish power and control wiring as required for the air blower and electrically operated hoist.

3.2 MANUFACTURER'S SERVICES

A. Provide the following on-site services by a factory trained service technician who is a full-time employee of the UV system manufacturer.

1. Installation: As many times as required for proper installation.
2. Start-up and field testing: Two days/one trip (on site) for installation checkout, IO and electrical checkouts, UV lamp installation, testing, calibration, and configuration of UV control system.
3. Operator training: Two days/two trips. Includes initial training and follow-up training on site for UV performance testing, maintenance training, maintenance assistance, classroom and on-site equipment operation instructions, troubleshooting, and other post-startup services.. Follow-up training (one day/one trip) shall be completed no sooner than 6-months and no later than 12 months from start-up date.

B. Additional local service support shall be made available to the Owner on request. These services shall be provided on a demand service basis at the manufacturer's current published service rates.

C. PERFORMANCE TESTING

1. A pass/fail performance test will be conducted during the start-up and operation demonstration period, see Specification Section 01655. Owner will be responsible for coordination of sampling and analysis cost.

END OF SECTION

SECTION 11280

LAUNDER COVERS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of all supervision, labor, materials, tools, equipment and incidentals to furnish and install all launder covers as required in the existing secondary clarifier units, as shown on the plans and described herein.

B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be approved by the Owner's Representative.

C. All equipment specified under this section shall be provided by a single manufacturer/supplier.

D. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume responsibility for the proper function of all equipment, following installation.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300 – Submittals and Section 01340 – Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Owner's Representative review.

C. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730 – Operations and Maintenance Data.

1.3 WARRANTY

Provide equipment warranty in accordance with the requirements of Section 01700 – Contract Closeout.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. All launder covers shall be constructed of molded Fiberglass Reinforced Plastic (FRP) panels, manufactured in accordance with Product Standard PS 15-69 Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment, latest revision of the National Bureau of Standard, United States Department of Commerce, attached together to form a continuous cover over the launder trough, weir, and scum baffle.

B. Ultraviolet absorbers shall be added to FRP resin to prevent deterioration from sunlight. All launder covers shall also be protected by a coating of Ultraviolet (UV)-stabilized polyurethane-based paint.

C. Each launder cover segment shall consist of two sections, a fixed mounting section and a hinged cover section. The mounting section shall provide a rigid support for the cover section and shall be fastened to the weir wall. The cover section shall be designed to swing open to provide access to the trough and weir for inspection and maintenance.

D. Launder covers panels shall be designed to ensure that alternate panels open independently of every other panel.

E. Provisions shall be made to lock the cover section in a closed position for safety and security. This may be accomplished by means of an easily operated latch mechanism that secures the hinged cover section to the support flange.

F. Neither the launder cover nor the means used to support it shall interfere with effluent flow over the weir or within the trough.

G. Where the circumference of the trough is interrupted by a bridge-support or other obstacle, a fixed panel(s) shall be installed over the trough beneath the support such that the surface of the launder cover is continuous around the entire tank.

H. Each launder cover shall be molded by the matched die method to produce uniform, smooth surfaces. All surfaces shall be smooth, resin rich, free of voids and porosity, without dry spots, crazes or unreinforced areas and shall provide for increased corrosion resistance and weathering.

2.2 ACCEPTABLE MANUFACTURERS

A. Provide equipment from one of the following acceptable manufacturers:

1. Glass-Steel, Inc.
2. NEFCO
3. Fiberglass Fabricators
4. Warminster Fiberglass Company
5. Or approved substitution.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01600, Materials and Equipment.

2.3 QUALITY ASSURANCE

A. Manufacturer of Fiberglass Reinforced Plastic (FRP) products shall have a minimum of 5 years' experience in the production of similar items.

B. The manufacturer shall maintain a continuous quality control program and shall, upon request, furnish Owner and Owner's Representative with certified test reports of physical sample tests to demonstrate the quality of material(s) used to manufacture the products specified herein.

1. Hardness tests shall be made with the resin-rich surface of the product.
2. Flexural tests shall be made with the resin-rich surface in compression.
3. Test samples shall be full thickness of the item produced and shall not be machined on the surface.
4. The procedures to be used in determining FRP properties shall be in accordance with the following ASTM standards: Ultimate Tensile Strength - ASTM Designation D638; Flexural Strength - ASTM Designation D790; Modulus of Elasticity - ASTM Designation D790; Impact - ASTM Designation D256; Water Absorption - ASTM Designation D570.

5. Minimum physical properties at a temperature of 75 F for the plastic shall be as follows:

Description	**Value**
Ultimate Tensile Strength	7,500 psi
Flexural Strength	16,000 psi
Flexural Modulus of Elasticity	800,000 psi
Impact, Notches, Izod (foot-pound/inch)	10.0
Barcol Hardness (minimum)	35
Average Coefficient of Thermal Expansion (inch/inch/degree F)	16×10^{6}
Water Absorption (percent 24 hours)	0.20

2.4 PRODUCT DESCRIPTION

A. Each launder cover shall be laminated to 3/8-inch thick minimum. Individual sections shall be a minimum of four feet in length and curved to follow the curvature of the tank. Additional reinforcement in the form of stiffening ribs shall be added when necessary. Oversize holes shall be provided on the plastic laminate for vertical and horizontal adjustment. Cut ends of non-standard lengths shall be properly sealed. Launder covers shall be walkable and allow for a live load of 100 psf.

B. All anchor bolts, fasteners, handles, hinges, latches, nuts and washers shall be type 316 stainless steel designed and constructed in accordance with ASTM A276.

C. All caulking compound shall be an acrylic polymer or a two-part sealant equal or exceeding Federal Specification TT-S-227B.

D. The tether cable shall consist of a length of stainless steel cable secured to the tank wall and the hinged cover section by means of stainless steel eyebolts. The length of the cable is selected to limit the travel of the cover section.

E. Provide spare parts in accordance with requirements of Section 01700 – Contract Closeout.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600 – Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Owner's Representative review.

B. Certification of all factory testing data and results shall be submitted for Owner and Owner's Representative review.

3.3 INSTALLATION

A. The launder cover sections shall be mounted to the weir wall on stainless steel or FRP brackets. The free end of each launder cover panel shall be supported at the outer tank wall by an FRP support flange that attaches to the entire periphery of the tank.

B. The installation contractor shall install the launder cover in accordance with the contract drawings, manufacturing drawings and manufacturer's recommendations. Field cutting of panels shall be allowed to complete the structure and accommodate in-tank obstructions. All cut ends shall be dressed as per the manufacturer's recommendations.

C. All fasteners and brackets required for installation shall be 304 Stainless Steel and shall be supplied by the launder cover manufacturer. The support flange and weir wall brackets are installed using 3/8" x 3-3/4" expansion anchors with flat washers, lock washers and hex nuts.

3.4 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by the both the manufacturer's factory representative and the Owner's Representative.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Owner's Representative.

3.5 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655 – Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661 – Instruction of Operation and Maintenance Personnel.

END OF SECTION

SECTION 11281

WEIRS, BAFFLES, AND LAUNDERS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of all supervision, labor, materials, tools, equipment and incidentals to furnish and install all weirs, baffles, troughs and related items as shown on the plans and described herein.

1.2 QUALITY ASSURANCE

A. Qualifications. Manufacturer of fiberglass reinforced fiberglass (FRP) products shall have a minimum of 5 years' experience in the production of similar items. Following are acceptable manufacturers of FRP products:

1. NEFCO.
2. Glass-Steel, Inc.
3. Fiberglass Fabricators
4. Warminster Fiberglass Company.
5. Or approved substitution.

1.3 EQUIPMENT WARRANTY

A. The manufacturer of the equipment shall warrant for one year from date of acceptance, that the equipment will be free from defects in design, material, and workmanship.

PART 2 - P R O D U C T S

2.1 WEIR AND BAFFLES

A. All weir plates, baffle plates, butt plates, and related components shall be fiberglass reinforced polyester plastic (FRP) manufactured in accordance with Product Standard PS 15-69 Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment, latest revision of the National Bureau of Standard, United States Department of Commerce, except for grit unit where the manufacture will provide stainless-steel. Ultraviolet absorbers shall be added to the resin to prevent deterioration from sunlight. They shall also be protected by a UV coating of UV-stabilized polyurethane-based paint.

B. Each weir, baffle, and splice plate shall be molded by the matched die method to produce uniform, smooth surfaces. All surfaces shall be smooth, resin rich, free of voids and porosity, without dry spots, crazes or unreinforced areas and shall provide for increased corrosion resistance and weathering.

C. The manufacturer shall maintain a continuous quality control program and shall furnish the Owner's Representative with certified test reports consisting of physical tests of samples as listed below and otherwise as required to show quality of material.

D. Hardness tests shall be made with the resin-rich surface of the product. Flexural tests shall be made with the resin-rich surface in compression. Test samples shall be full thickness of the item produced and shall not be machined on the surface. Manufacturer shall furnish test results to the Owner's Representative.

E. The procedures to be used in determining the FRP properties listed in the following tables shall be in accordance with the following ASTM standards: Ultimate Tensile Strength - ASTM Designation D 638; Flexural Strength - ASTM Designation 790; Modulus of Elasticity - ASTM Designation D 790; Impact - ASTM Designation D 256; Water Absorption - ASTM Designation D 570.

F. Minimum physical properties at a temperature of 75 F for the plastic shall be as follows:

Description	Value
Ultimate Tensile Strength	7,500 psi
Flexural Strength	16,000 psi
Flexural Modulus of Elasticity	800,000 psi
Impact, Notches, Izod foot pound per inch	10.0
Barcol Hardness, minimum	35
Average Coefficient of Thermal Expansion - inch per inch, per degree F	16×10^{6}
Water Absorption, percent 24 hours	0.20

G. Each weir plate, baffle plate, and splice plate shall be laminated to 3/8-inch thick minimum and molded to the sizes and shapes as shown in the drawings and described herein. Oversize holes shall be provided on the plastic laminate for vertical and horizontal adjustment. Cut ends of non-standard lengths or weirs shall be properly sealed.

H. All anchor bolts, nuts and washers shall be type 316 stainless steel designed and constructed in accordance with ASTM A276.

I. All caulking compound shall be an acrylic polymer or a two-part sealant equal or exceeding Federal Specification TT-S-227B.

2.2 COMPONENTS

A. Secondary Clarifier Weirs.

1. Provide 12-inch deep weir plate for each circular clarifier; fabricate in lengths to suit the clarifiers. Lengths shall not exceed 12 feet.

2. Weirs to be 90-degree V-notch type, 2 inches deep, spaced on 6-inch centers.

3. Provide oversize mounting holes for vertical and horizontal adjustment. Mounting holes shall be provided at 24-inch maximum centers for circular basin walls.

4. End of weir plates shall be secured with butt plates arranged to allow for horizontal expansion.

5. With a non-standard length of mounting hole configuration, the machined or cut face shall be resin sealed.

6. Final weir plate adjustment shall be performed by the Contractor after installation of troughs. Weir plates shall be adjusted to compensate for designed upward deflection and to bring weir plates to correct crest elevation. Design deflection shall be L/1000 between supports.

B. Secondary Clarifier Baffles.

1. Scum Baffles

a. Provide 15-inch deep baffle plates for each circular clarifier; fabricate in lengths to suit the basins. Lengths shall not exceed 12 feet.

b. Provide plates with mounting holes on approximately 48-inch centers to attach to support brackets.

c. Provide FRP support brackets with molded gussets on each side that allow for at least 1-inch vertical and horizontal adjustment. Provide necessary joint plates and butt plates.

d. With a non-standard length configuration, the machined or cut face shall be resin sealed.

2. Stamford Baffles

a. Provide Stamford Baffles for density current redirection for each circular clarifier. The thickness shall be a minimum of 3/8-inch.

C. Secondary Clarifier Launders

1. Provide 1-foot wide launders that are 1-foot deep. The wall thickness shall be a minimum of 3/8-inch. Coordinate with the clarifier manufacturer for launder requirements.

D. Grit Chamber Effluent Weirs

1. Provide 12-inch deep stainless-steel weir plates for each grit chamber effluent.

2. Provide mounting to allow for at least 6-inch vertical and horizontal adjustment. Provide necessary joint plates and butt plates.

3. End of weir plates shall be secured with butt plates arranged to allow for horizontal expansion, except in the cases where a single weir length achieves the complete span.

4. With a non-standard length of mounting hole configuration, the machined or cut face shall be resin sealed.

5. Final weir plate adjustment shall be performed by the Contractor. Weir plates shall be adjusted to compensate for designed upward deflection and to bring weir plates to correct crest elevation. Design deflection shall be L/1000 between supports.

E. Aeration Basin Baffle Walls

1. Provide prefabricated baffle walls according to the drawings. Manufacturer to design and provide mounting system.

F. Aeration Basin Effluent Weir Boxes

1. Provide 2-foot deep, 4-foot wide, 2-foot tall open-topped effluent weir box for each Aeration Basin train, mounted to basin wall as shown in the drawings.

2. Allow for connection of 8" pipe in bottom of weir boxes, as shown in the drawings. This box needs to be an adjustable weir

PART 3 - EXECUTION

3.1 INSTALLATION

A. The weirs and splice plates shall be installed in full accordance with the manufacturer's recommendation, by mechanics skilled in the installation of this type of work and under the supervision of the manufacturer's representative.

B. Field adjust weirs to elevations shown on the plans. Caulking compound shall be used at the top and bottom contact points of each surface of the weirs and face of concrete to completely prevent flow of liquid between these contact surfaces.

C. Level tolerance is zero and is to be accomplished by filling the tank with water and leveling the weir to the water surface.

D. All weirs shall be installed in accordance with Contract Documents.

END OF SECTION

SECTION 11290

SLIDE GATES AND SLUICE GATES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of all supervision, labor, materials, tools, equipment and related items to furnish and install slide gates, sluice gates, hand gates, stop logs, and gate operators, as shown on the drawings and described herein. See the table of gates in Part 2.

B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be approved by the Owner's Representative.

C. All equipment of the same type specified under this section shall be provided by a single manufacturer/supplier.

D. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume responsibility for the proper function of all equipment, following installation.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300 – Submittals, and Section 01340 – Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Owner's Representative review.

C. Submit the manufacturer's affidavit of compliance with the provision of AWWA Specification C-501 cast iron sluice gates, or C560 cast-iron slide gates, or C561 fabricated stainless steel slide gates, or C562 fabricated aluminum slide gates (latest edition) and these specifications.

D. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730 – Operation and Maintenance Data.

1.3 WARRANTY

Provide equipment warranty in accordance with the requirements of Section 01700 – Contract Closeout.

1.4 REFERENCES

A. AWWA Specification C-501
B. ASTM B209 6061-T6
C. ASTM 1056
D. ASTM A276
E. ASTM B221 6061-T6
F. ASTM D2000
G. ASTM D1248

H. ASTM D3935 D707
I. ASTM B584 C86500

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. Equipment provided under this section shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer.

B. Gates and operators shall be furnished with all necessary parts and accessories indicated on the drawings, specified or otherwise, required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of cast or fabricated gates.

C. All gates shall be furnished with the option to utilize an electric nut driver and provide two nut drivers.

D. Furnish and install gates per the requirements of the following table and as specified herein:

Designation	Location	Material	Quantity and Gate Type	Design Head Seating (S)/ Unseating (U)	Self-Contained?	Stem & Operator Type	Opening Size	Invert Elevation	Top of Wall Elevation
SG-203A and 203B	Headworks (Bar Screen)	Stainless Steel	2, round flange-mounted slide gates	6.67 ft S (no U)	Y	Rising stem w/yoke and handwheel	1 ft (round)	17.23	25.35
SG-400	Aeration Basin	Aluminum	1, Rectangular surface-mounted slide gate with surface-mounted floor invert	19.75 ft S and 19.75 ft U	N	Rising stem with floor stand and hand crank	4 ft x 4 ft	2.58	26.58

2.2 ACCEPTABLE MANUFACTURERS

A. Provide equipment from one of the following acceptable manufacturers for metal gates:

1. Golden Harvest, Inc.
2. Fontaine Aquanox (by ISE Metal Inc.)
3. RW Gate
4. Whipps, Inc.
5. HydroGate
6. Waterman Gates
7. Or approved substitution.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01600 – Materials and Equipment.

2.3 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of 5 years' experience in the production of similar items.

B. Except as modified or supplemented herein, all gates and operators shall be manufactured in conformance to the applicable requirements of AWWA specifications called out in paragraph 1.2 C. above.

C. Manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of ANSI/AWS D1.1 or ASME Section 9.

D. Fully assembled gate(s) shall be shop inspected, adjusted and tested for operation and leakage prior to shipping.

E. Slide gates and the weir gates shall meet or exceed AWWA specifications called out in paragraph 1.2 C. above. (latest edition) leakage rate standards.

2.4 PRODUCT DESCRIPTION

A. Material of Construction

1. All stainless steel referenced in this specification shall be Type 304, ASTM A240 or ASTM A276 unless otherwise indicated herein.

a. All welded stainless-steel components shall be constructed of Type 304L stainless steel.
b. All structural stainless steel used in the construction of slides and frames shall have a minimum material thickness of 1/4-inch.
c. All non-welded stainless-steel components, excluding anchor bolts and assembly bolts, shall be Type 304 or Type 304L stainless steel.
d. Anchor bolts and assembly bolts shall be Type 316 stainless steel.

B. Slide.

1. The slide shall consist of a stainless steel or aluminum plate that is reinforced with stiffeners to withstand the specified head conditions. The slide shall engage the frame a minimum of 1-inch on each side.

a. The slide shall be reinforced with plates or channel shaped members to restrict deflection to 1/16-inch or less at the design head.
b. The stiffeners shall be welded to the slide plate in the horizontal and vertical positions.
c. The portion of the slide that engages the frame shall have a minimum thickness of 1/2-inch.
d. On rising stem gates, a stem connector shall be welded to the slide as a means of connecting the operating stem. The bottom portion of the stem shall be affixed to the stem connector with a minimum of two attachment bolts.

e. On non-rising stem gates, the slide shall be arranged to allow travel of the stem along the length of the slide.

C. Gate Frame.

1. The frame shall be constructed of stainless steel or aluminum plate, with the guide section formed into a C channel shape or similar to house the seal, and shall be reinforced to withstand the specified operating conditions.

a. The guides shall be of a one-piece design with gussets that extend along the outside and top to accommodate unseating head. The guide members shall incorporate a tubular cross section along the guides for additional rigidity. Two-piece, sandwich type guides that are bolted together are not acceptable.
b. The mounting configuration of the frame shall be as shown on the Contract Drawings.
c. Wall mounted frames shall be of the flanged frame type. Flat frames shall only be provided on gates with frames that will be embedded in the concrete wall or mounted inside existing channels.
d. The guide portion of flanged frame gates shall have a minimum weight of 13 lbs./ft. The portion of the flanged frame, where the anchors penetrate, shall have a minimum thickness of 1/2-inch.
e. The guide extension portion of the frame shall have a minimum weight of 6 lbs./ft. Angles are not considered acceptable guide extensions.

f. Lifting lugs shall be provided on all frame styles.

g. On self-contained gates, the side frame shall extend above the operating floor and the operating mechanism shall be mounted to the yoke. When shown, the frame may extend to or below the operating floor and a floor stand may be mounted on the yoke.

h. Yoke members shall be C channel shaped structural members. Angles are not considered acceptable yoke members.

D. Gate Seals.

1. The seal system shall consist of self-adjusting UHMWPE seals with a nitrile or EPDM compression cord.

a. The UHMWPE seals shall be arranged to ensure that there is no metal-to-metal contact between the slide and frame.

b. The compression cord shall be contained by the UHMWPE seal so that it shall not be in contact with the slide.

c. Seal system shall be self-adjusting for the life of the gate. Adjustable wedging devices such as wedges, wedge bars and pressure pads are not acceptable.

d. On upward-opening gates, rubber side seals and/or top seals such as J-bulb seals or similar rubber seals are not acceptable in lieu of UHMWPE seals.

e. On downward opening gates, rubber side seals and/or invert seals such as J-bulb seals or similar rubber seals are not acceptable in lieu of UHMWPE seals.

f. The invert seal on upward opening gates shall use a compressible EPDM seal located in the invert of the frame.

1) The invert seal shall be of a flush bottom arrangement.

2) The invert seal shall be mechanically fastened with stainless steel bolts.

3) Invert seals attached solely by the use of adhesives are not acceptable.

g. All seats and seals shall be secured with assembly bolts. All seals shall be field removable and field replaceable without the need to remove the gate frame from the wall. Gates that require disassembly of any portion of the frame, to replace seals, are unacceptable.

h. Anchor bolts shall not penetrate the seats or seals and anchor bolts shall not prevent the removal or replacement of seats or seals.

i. The seal system shall have been shop tested with a minimum 30,000 cycle operating test in an abrasive environment to confirm the ability of the seals to withstand the abrasive condition with negligible deterioration and to confirm that the leakage restriction requirement is still possible.

1) The shop test shall have been performed on a stainless-steel sluice gate and the test results shall have been certified by the manufacturer in writing.

2) A copy of the test shall be provided to the Engineer.

E. Gate Stem.

1. The operating stem shall be of stainless steel and shall be designed to transmit in compression at least 2 times the rated output of the manual operating mechanism with an 80 lbs. effort.

2. The stem shall have a slenderness ratio (L/r) less than 200.

3. The threaded portion of the stem shall have a minimum diameter of 1-1/2 inches.

a. The threads shall have machine rolled, full depth ACME threads.

b. Stub threads are not acceptable.

4. Stems provided in multiple pieces shall be provided with couplings.

a. Couplings shall be bronze or stainless steel and shall be internally threaded and keyed or bored and bolted.

5. Stem guides shall be constructed of stainless steel with UHMWPE bushings.

6. Gates with rising stems shall be provided with a clear plastic stem cover.

a. The stem cover shall be butyrate and shall have a cap and condensation vents.

b. Clear mylar indicating tape shall be provided for field application after the gate has been installed and positioned.

7. Stop collars shall be provided to limit the downward travel on gates with manual operating mechanisms.
   a. Stop collars shall be bronze and shall be internally threaded and provided with a stainless-steel set screw.

F. Fasteners. All necessary attaching nuts, bolts, studs and anchors shall be ASTM A276 Type 304 stainless steel and shall be furnished by the gate manufacturer.

G. Gate Operator.

1. Operating mechanisms shall be provided by the gate manufacturer.
2. Manual operators shall be yoke mounted on self-contained gates or floor stand mounted when shown in the Contract Documents.
   a. Manual operators shall be of the bevel gear type suitable for operation with a portable operator.
   b. Gear ratios shall be selected by the gate manufacturer to ensure that the maximum operating effort is 40 lbs at the design head.
   c. Minimum gear ratio shall be 2:1.
   d. Gearboxes shall have ductile iron housings, a bronze lift nut, steel gears and a stainless-steel input shaft.
   e. Ball or roller bearings shall support the lift nut and input shaft.
   f. The housing shall be grease lubricated and permanently sealed.
   g. Handwheels shall be provided. Handwheels shall have a maximum diameter of 24 inches.
   h. Adaptor plates shall be utilized to attach the operating mechanism to the yoke. Adaptor plates shall be stainless steel and shall have a minimum thickness of 3/4-inch.
3. Interconnected gearboxes and multiple stems shall be provided to ensure proper operation of wide gates.
   a. Interconnected gearboxes are required on all upward opening gates when the opening width is greater than 60 inches and the height of the slide is less than half of the width.
   b. Interconnected gearboxes are required on all downward opening gates when the opening width is greater than 48 inches and the height of the slide is less than half of the width.
   c. Interconnected gearboxes shall consist of a stainless-steel interconnecting shaft with flexible couplings on each end and stainless-steel hardware. Aluminum shafts are not acceptable.
   d. Gates with interconnected gearboxes, driven by an electric motor operator, shall be provided with a shroud to cover the interconnecting shaft.
   e. The shroud shall be removable.
   f. The shroud shall be constructed of stainless steel and shall have a minimum thickness of 20 gauge.

H. Floorstands and Wall Brackets

1. Floorstands shall be mounted to the concrete, mounted to a wall bracket or mounted on the yoke of a self-contained gate as shown on the Contract Drawings.
2. All floorstands and wall brackets shall be fabricated from stainless steel.
   a. The base plate, adaptor plate and gussets shall be minimum 1/2-inch thick.

I. Anchorage

1. Anchor bolts shall be 316 stainless steel, fully threaded and shall have a minimum diameter of 1/2-inch.
   a. Anchor bolts shall be of the epoxy type.

J. Finish

1. All heat tint and slag from the welding process shall be passivated in accordance with ASTM A380. If bead blasting is used, the entire slide and entire frame shall be bead blasted.

2. All ferrous components shall be suitably prepared and then shop coated with primer. Finish coating shall be applied by the Contractor. The ductile iron operator housing shall be finish coated by the Contractor with a suitable paint that complies with the Painting section.

K. Spare Parts. Provide spare parts in accordance with requirements of Section 01070 – Contract Closeout.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600 – Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Owner's Representative review.

B. Certification of all factory testing data and results shall be submitted for Owner and Owner's Representative review.

3.3 INSTALLATION

A. Install all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

B. Prior to grouting completion, equipment alignment and installation shall be checked and approved by the manufacturer's factory representative. All grout required shall be the non-shrink type cement mortar. The installation shall be rechecked and approved by the manufacturer's factory representative following grouting completion.

C. Tighten all anchor bolts following grouting.

D. Following the completion of each gate installation, gates shall be operated through at least two complete open-close cycles.

E. Gates shall be leak-tested by the Contractor, per the requirements specified herein.

3.4 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by the both the manufacturer's factory representative and the Owner's Representative.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Owner's Representative.

3.5 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655 – Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661 – Instruction of Operation and Maintenance Personnel.

END OF SECTION

SECTION 11312

DISC FILTER

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of packaged Cloth Media Filter systems for one self-contained filter basin as outlined in the drawings with all necessary parts and equipment to provide proper function of the system. All equipment provided shall comply with the following specifications. The manufacturer, at his discretion, may supply multiple filter systems in each basin.

B. The following specifications are intended to detail a system that is in compliance with the National Electrical Code and OSHA standards to ensure a safe working environment for the operating personnel. Further considerations have been given to ease maintenance and operation activities.

C. The Contractor shall be responsible for additional design and costs associated with modifying the concrete filter basins to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes filter package system equipment supplied by manufactures that may differ from the dimensions shown on the drawings. All designs must be approved by the Engineer through the submittal process.

D. All of the equipment called for under this section of the specifications shall be supplied by the filter supplier. The supplier shall, in addition to the Contractor, assume the responsibility for the proper function of the equipment.

1.2 SUBMITTALS

A. Product Data. Submit product data for review in accordance with Sections 01300 – Submittals. Each set of data shall include but not be limited to:

1. Drawings showing concept of equipment functionality (such as flow path).
2. Control details.
3. Performance data including, but not limited to, pump curves, California Title 22 approval, motor data, gear reducers, etc.
4. All other information necessary to determine whether the proposed equipment meets the specified requirements.
5. Complete assembly drawings of filter components giving type of materials, dimensions, and location of each item.
6. List of any exceptions or deviations, with reasons and calculations supporting such exceptions or deviations.
7. Recommended spare parts for 2 year's normal maintenance with prices, delivery and location of stock (local or factory).

B. Shop Drawings. Complete drawings, details and specifications for the filters and their accessories and appurtenances shall be submitted for review in accordance with Section 01300 - Submittals. This data shall include but not necessarily be limited to:

1. Drawings showing details, dimensions, and weights of major components and minimum recommended spacing.
2. Drawings showing minimum, and maximum water levels and weir settings.
3. Control details and electrical schematic diagrams.
4. Control details provided shall include details on circuit breakers, motor starters, limit switches and other electrical components pertinent to proper functioning of the equipment.

5. Where applicable, performance data shall be submitted: pump curves, underdrain information, etc.

6. General information on the unit and its components to determine if the proposed equipment meets the specifications.

7. Equipment layout drawings.

C. Operation and Maintenance Manuals. Provide operation and maintenance manuals in accordance with provisions of Section 01300 – Submittals, Section 01661 - Instruction of Operation and Maintenance Personnel, and section 01730 – Operation and Maintenance Data.

1.3 WARRANTY

A. Provide Warranty as required under Section 01700 – Construction Closeout.

PART 2 - P R O DU C T S

2.1 DESIGN CRITERIA

Phase I*		
Average Daily flow rate (ADF)	.5/ 348	(MGD)/(GPM)
Peak 2 hr. Hydraulic flow rate	1.5/ 1,042.0	(MGD)/(GPM)
Phase II		
Average Daily flow rate (ADF)	1.0/ 694.5	(MGD)/(GPM)
Peak 2 hr. Hydraulic flow rate	3.0/ 2,083.0	(MGD)/(GPM)
Phase III*		
Average Daily flow rate (ADF)	1.5/ 1,042.0	(MGD)/(GPM)
Peak 2 hr. Hydraulic flow rate	4.5/ 3,125.0	(MGD)/(GPM)
TSS	15	Mg/L/<30mg/L
Minimum Media Surface Area Phase I	160.26**	ft^2
Minimum Media Surface Area Phase II	320.51**	ft^2
Minimum Media Surface Area Phase III	480.77**	ft^2
Equipment Maximum Filtration Rate	6.5	gal/min/ ft^2
Maximum Allowable Headloss***	0.63	ft
Media Pore Size	10	Microns
Backwash Flux Rate	6.0	gal/min/ft^2

* Filter tank shall be supplied to accommodate Phase III peak 2-hr design flow rate. Number of disks and ancillary equipment to be supplied shall, at a minimum, accommodate average daily and peak 2-hour flow for Phase I.

** To include only the filtration area in service at any particular time (i.e. area above water are excluded, filter area blocked by frame attachments are excluded, filter area that cannot be backwashed is excluded).

***Headloss from filter influent weir to effluent discharge. Filter must fit within requirements of proposed hydraulic profile and process mechanical drawings.

A. Units shall be California Title 22 approved.

B. Units shall comply with requirements of 30 TAC § 217.190 and 217.193. Filter units are provided solely to polish wastewater prior to UV disinfection: 1) as a condition of the UV performance guarantee; 2) for potential power cost reduction associated with the operation of the UV system; and 3) potential future Type I reuse water

provision. Therefore, a performance guarantee for a maximum filter TSS concentration of 10 mg/L at flows up to the maximum design rate is required due to requirements for disinfection guarantees by the UV manufacturer.

2.2 MANUFACTURERS

Provide Cloth Media Filter as manufactured by:

A. Five Star Filtration

B. Alfa Laval

C. Aqua-Aerobic System, Inc.

D. Approved Substitution

2.3 QUALITY ASSURANCE

A. The supplier shall satisfy the Engineer that the following are maintained in the greater Houston/Galveston metropolitan area:

1. A manufacturing branch or manufacturer's representative storing a representative supply of parts for the equipment specified, and provisions for securing parts within a reasonable length of time.

2. A service facility staffed with quality factory-trained service personnel.

3. Pickup and delivery trucks for parts, etc.

2.4 FILTER CLOTH ASSEMBLIES

A. Each filter shall include cloth disc assemblies. Each cloth disc assembly shall consist of a cloth media sock supported by a frame. Cloth/frame assemblies shall be constructed such that each individual cltoh media sock is easily removable, without special tools, to allow for replacement.

B. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered. Cloths shall be of woven material including polyester to have a nominal filtration rating of 10 microns.

C. Non-fabric screens having structured identical openings shall not be allowed. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss.

2.5 FILTER DISC BASIN

A. Filters shall be installed in a 316 stainless steel basin provided by manufacturer. Basin shall be sized to accommodate Phase III flows as identified in Section 2.1.

2.6 DRIVE INSTALLATION

Each filter unit shall include either: an adjustable drive installation with a gearbox, nylon drive sprocket, nylon drive chain with 18-8 stainless steel link pins, and a 304 stainless steel chain guard; or a worm gear screw jack. Belt driven systems will not be acceptable. The gearbox for worm gear screw jacks shall be parallel in-line helical type or right angle type, AGMA class 1. The drive motor horsepower will be as determined by the manufacturer, and rated for 480-volt, 3 phase, 60 HZ.

2.7 CENTER TUBE/DRUM

A. If required, the center tube shall be constructed of 304 stainless steel.

B. Bearings, if needed, shall be lubricated.

2.8 BACKWASH / SLUDGE DISCHARGE INSTALLATION

A. The backwash function shall incorporate pumps that uses filter effluent water to remove accumulated solids from the cloth surface.

B. The manufacturer shall provide pumps, motors, piping, valves, acutators, drain piping, collection troughs/headers, pressure gages, nozzles, level sensors, and controls to complete a fully automatic backwash system performing the intended work of removing solids form the cloth surface.

C. The backwash pumps shall be centrifugal pumps with 480 Volt, 3 phase, 60 Hz motor not to exceed 15 Hp.

D. Filtering shall not be interrupted during normal backwashing and sludge discharge.

2.9 VALVES

A. Filter manufacturer is responsible for providing the valves and actuators required for proper function of equipment. Valves must meet requirements specified in Section 15139 – Wastewater Valves.

2.10 CONTROL SYSTEM AND INSTRUMENTATION

A. Filter control system shall be designed and assembled according to Section 13413 – Control Panels and per manufacturer's standards and recommendation to complete one fully automated filter packaged system.

B. Filter instrumentation shall be designed and assembled according to Section 13421 – Instruments and per manufacturer's standards and recommendation to complete a fully automated filter packaged system.

C. The automatic and manual controls for operation of disk filter systems shall be furnished fully assembled, wired and pre-programmed in a control enclosure. Control system to be non-proprietary. Program and documentation to be provided to the Owner.

D. Control Enclosure. The enclosure shall comply with Section 13413 – Control Panels and 13410 – Programmable Logic Controllers (PLC)

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store and protect all equipment in accordance with the requirements of Section 01600 – Materials and Equipment.

B. Deliver, handle, store and protect all equipment in accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Engineer review.

B. Certification of all factory testing data and results shall be submitted for Owner and Engineer review.

3.3 INSTALLATION

A. Install all equipment in accordance with manufacturer/supplier recommendations and/or instructions.

3.4 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, approved by both the manufacturer's factory representative and the Owner's representative.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Engineer.

3.5 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655 – Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

C. Checkout of final installation, start-up, calibration and instruction of operating personnel shall be performed by an authorized representative of the manufacturer. Startup service to be performed in one (1) trip of one (1) day.

3.6 PRE-CONSTRUCTION REQUIREMENTS

A. Contractor shall coordinate construction activities with Owner and the Engineer.

B. The Contractor shall follow the schedule of activities submitted to the Engineer for approval.

3.7 MANUFACTURER'S SERVICES

The equipment manufacturer shall provide the services of a factory-trained representative for a minimum period of two days to perform initial start-up, to instruct the Owner's operating personnel in the operation and maintenance of the equipment and to adjust the equipment for satisfactory operation. The manufacturer's representative performing this service shall be a direct employee of the equipment manufacturer, normally engaged in this type of service work. The equipment manufacturer shall also furnish the services of a competent field engineer to instruct the Contractor in the installation of the filter and to inspect the completed filter.

END OF SECTION

SECTION 11319

SUBMERSIBLE PUMPS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of six (6) non-clog submersible sewage pumping units. As indicated on the drawings, three (3) of these pumps shall be installed in a dry pit application at the RAS pumping station, two (2) of these pumps shall be installed in the packaged Scum Pit, and one (1) of these pumps shall be installed in the Sludge Holding Tank as part of the Jet Mixing System. The RAS pumps shall be identified as P-411, P-412, , and P-413. The Scum pumps shall be identified as P-421, and P-422. The Jet Mixing pump shall be identified as P-701. Each installation shall include the setting of pumps and motors, leveling and aligning of equipment, and connection to piping to provide a complete operational pumping system, as well as other specified accessories. Pumps P-411, P-412, and P-413 shall be variable speed controlled.

B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be approved by the Owner's Representative.

C. All equipment specified under this section shall be provided by a single manufacturer/supplier.

D. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume responsibility for the proper function of all equipment, following installation.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300 – Submittals, Section 01340, Shop Drawings, Product Data and Samples, and 01700, Contract Closeout.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Owner's Representative review.

C. Product Data. Submit product data for review; include the following:

1. Manufacturer of pump, size, type, and figure number.
2. Manufacturer of electric motor and guaranteed efficiency at pump rated conditions.
3. Guaranteed performance curves (manufacturer's standard certified test data) for each pump, including head curve, horsepower curve and efficiency curve. Curves shall indicate recommended minimum flow rate, maximum attainable flow rate at rated pump speed, brake horsepower at rated conditions, and maximum horsepower over entire pump performance curve, including shutoff.
4. Guaranteed pump efficiency at rated conditions.
5. Recommended spare parts for 1 year's normal maintenance with prices, delivery and location of stock (local or factory).

D. Shop Drawings. Complete drawings, details and specifications for the pumps and their accessories and appurtenances shall be submitted for review; include the following:

1. Certified dimensioned outline drawings for pumping units and motors with shipping weights and unit weight.
2. Cross-sectional drawing with detailed parts list for pumps and motors.

E. Testing and Final Submittals.

1. Factory performance tests, in accordance with the standards of the Hydraulic Institute, shall be required for all sewage pumps with discharge size 10 inches and larger. Six copies of certified factory

performance test curves and a copy of the actual test data shall be submitted prior to shipment, including head, capacity, brake horsepower and pump efficiency characteristics for each pump supplied.

2. The following data shall be submitted upon shipment of pumps and motors:
   a. Installation, operation, maintenance and lubrication manuals.
   b. Complete bill of materials to include factory part numbers, or drawing numbers, which would indicate interchangeability, materials of construction, and the number of parts used in one unit.
   c. Labeled photographs of nameplate on pumps and motors. Pump nameplate shall include impeller size or number.

1.3 QUALITY ASSURANCE

A. Manufacturer/supplier shall have a minimum of 20 years of equipment production/installation experience.

B. Equipment shall be identified with a corrosion resistant nameplate and include manufacturers name, address, equipment model number and other pertinent information.

C. A factory-trained service engineer employed by the pump manufacturer shall advise the installing contractor in the installation and start-up of the pumping units. Upon completion of the physical installation of the unit, the manufacturer shall submit in writing to the Owner's Representative a letter stating that the unit has been properly installed and is acceptable for operation. The pump manufacturer's service engineer shall include in his bid two working days to advise the Owner's operator of operation and maintenance of the pumping units and controls.

D. Supply of Equipment. All equipment called for under this section of the specifications shall be supplied by the pump manufacturer. This includes the motors, and control panel.

1. For the Scum Pump packaged lift station, this shall also include the liquid level controls, lifting devices, and access doors. The supplier shall, in addition to the Contractor, assume the responsibility for the proper functioning of the equipment.

E. Parts and Service. The supplier shall satisfy the Owner's Representative that he maintains the following within a reasonable distance from the project location:

1. A store or branch storing a representative supply of parts for the equipment specified, and provisions for securing parts within a reasonable length of time.
2. A shop staffed with qualified factory-trained service personnel.
3. Pickup and delivery trucks for parts or pumps.

1.4 NOISE AND VIBRATION

A. Select equipment to operate with minimum of noise and vibration. If, in the opinion of the Owner's Representative, objectionable noise or vibration is produced or transmitted to or through building structure by equipment, piping ducts, or other parts of work, rectify such conditions without change in the contract sum.

B. If equipment is judged by the Owner's Representative to produce objectionable noise or vibration, the Contractor, at his expense, must demonstrate that the equipment performs within limits set forth on the vibration chart at the end of this section.

1.5 WARRANTY

A. The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of 5 years under normal use, operation and service. The warranty shall be in printed form and apply to all similar units. Warranty shall commence upon the date of substantial completion.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. RAS Pumps - See attached data sheet for P-411, P-412, and P-413.

B. Scum Pump Station - See attached data sheet for P-421, and P-422.

C. Jet Mixing Pump – See attached data sheet for P-701.

2.2 ACCEPTABLE MANUFACTURERS

A. Wilo (as provided by K2 Services)

B. Flygt

C. Approved substitution.

2.3 PUMP TYPE

A. Select pumps to operate conservatively over the entire range of total head as specified for each pump. Select pumps with head curves constantly rising toward shutoff and with efficiency curves which peak at or to the left of rated conditions.

B. The RAS pumps shall be non-clogging, raw sewage submersible type for operation in a dry condition. The scum pumps shall be a chopper type submersible pumps for operation in a submerged condition. The Jet Mixing pump shall be a chopper type submersible pump for use in a submerged condition. Each unit shall be equipped with a submersible electric motor, completely shop assembled in the pump manufacturer's plant, accurately aligned and properly prepared for shipment.

2.4 SCUM PUMP WET WELL SYSTEM DESIGN

The scum pumps shall be provided as a complete system with wet well and floats and shall be capable of handling raw, unscreened sewage. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. Anchor bolts for the discharge connection elbow shall be Type 316 stainless steel. The scum pumps shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. There shall be no need for personnel to enter wet well to either disconnect or reconnect the scum pump. Sealing of the scum pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the scum pump unit. The entire weight of the pumping unit shall be guided by no less than two stainless steel guide bars to and pressed tightly against the discharge connection elbow, with metal-to-metal contact. Sealing of the discharge interface by means of a diaphragm, O-ring, or other devices will not be acceptable. No portion of the scum pump shall bear directly on the floor of the wet well. The pump, with its appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 65 feet. Each pump shall be provided with a Type 304 or Type 316 stainless steel lifting cable secured to a stainless-steel eyebolt embedded in the lift station top slab or bolted to the underside of the access door frame.

2.5 CASING

A. Each pump casing shall be constructed of fine-grained cast iron and designed for side tangential discharge. Diffusion vanes are not permitted. The casting shall be designed for a minimum working pressure of 50 psig and hydrostatically tested to 1-1/2 times the working pressure.

B. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces, resulting in controlled compression of nitrile rubber O-rings without the requirement of a specific torque limit to effect this. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

2.6 PUMP SHAFT

A. The pump shaft shall be of stainless, a nickel-bearing chromium steel designed for heat treatment to high mechanical properties with superior corrosion-resistant characteristics. Non-stainless-steel pump shafts having direct contact with the raw sewage are not acceptable. The pump shaft shall rotate on two permanently lubricated ball or roller bearings. The shaft shall be of sufficient diameter to assure rigid support of the impeller and to prevent excessive vibration at all operating speeds.

B. Each pump shall be provided with a tandem mechanical rotating shaft seal system running in an oil reservoir having separate, constantly hydrodynamically lubricated lapped seal faces. The lower seal unit between the pump and oil chamber shall contain one stationary and one positively driven rotating tungsten-carbide ring. The

upper seal unit between the oil sump and motor housing shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon ring. Each interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment but shall be easily inspected and replaceable.

2.7 OIL CHAMBER

Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall house a pressure equalizer ring filled with air for oil pressure compensation. The drain and inspection plug, with positive anti-leak seal, shall be easily accessible from the outside.

2.8 IMPELLER

The pump impellers shall be one-piece cast iron, fully enclosed, designed with wide passages to prevent clogging when pumping solids, trash, rags and string material entrained in sewage. The impeller shall be statically and dynamically balanced. The impeller hub shall be accurately fitted to the impeller shaft and secured to a straight fit on the shaft by means of a key and threaded locknut. Impeller and casing shall be designed to pass the minimum test sphere size scheduled hereinafter. Clearance between the rotating and stationary parts shall be adjustable to provide sustained performance without excessive maintenance.

2.9 WEAR RING

A wear ring system shall be installed to provide efficient sealing between the volute and impeller. The wear ring shall consist of a stationary ring made of nitrile rubber molded with a steel ring insert which is drive fitted to the volute inlet, and a rotating stainless-steel Type 304 ring which is drive fitted to the impeller eye.

2.10 COOLING SYSTEM

A. Each unit shall be provided with an adequately designed cooling system, consisting of a motor cooling jacket which encircles the stator housing. The water jacket shall be provided with a separate circulation of the liquid. Cooling media channels and ports shall be non-clogging by virtue of their dimensions. Provision for external cooling and flushing shall also be provided. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures up to 110 deg. F.

B. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase). These shall be used in conjunction with and supplemental to, external motor overload protection and wired to the control panel.

2.11 ELECTRICAL CABLE SEAL

The electrical cable entry water seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. It shall be comprised of a dual cylindrical elastomer grommet flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the motor interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems are not acceptable.

2.12 MOTOR

A. Pump motors shall be NEMA Design B, squirrel-cage, induction, shell-type design, inverter rated, housed in an air-filled watertight chamber in accordance with Specifications 16222 and Specification 16223, as applicable. The stator winding and stator leads shall be insulated with moisture-resistant Class H insulation which will resist a temperature of 356 deg F. The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is not acceptable. The motor and the pump shall be produced by the same manufacturer. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall be designed for continuous

duty, capable of sustaining a minimum of 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum.

B. The junction chamber, containing the terminal board, shall be sealed from the motor by elastomer compression seal (O-ring). Connection between the cable conductors and stator leads shall be made with threaded compressed-type binding posts permanently affixed to a terminal board and, thus, perfectly leak proof.

C. The pump motor cables installed shall be suitable for submersible pump application and shall have Mine Equipment Safety Association approval; such approval shall be indicated by code or legend permanently embossed on the cable. Cable sizing shall conform to NEMA-IPCEA specifications for pump motors.

D. Provide and series connect temperature switches for each motor winding. Furnish intrinsically safe control relay for installation by the System Integrator.

E. Provide leak switch for pump/motor. Furnish intrinsically safe control relay for installation by the System Integrator.

2.13 EXPOSED SURFACES

All exposed nuts and bolts shall be of stainless steel, Type 304 or 316. All surfaces coming into contact with sewage, other than stainless steel, shall be protected with coal-tar epoxy in accordance with Division 9 - Finishes.

2.14 GUIDE BARS

Provide guide bars of Schedule 40, Type 304 or 316 stainless steel, and of the size recommended by the pump manufacturer. Intermediate guide bar guides shall be furnished, in accordance with the pump manufacturer's recommendation.

2.15 ACCESS DOORS AND GUIDES

A. Provide any mounting hardware or additional components required for new pump installation. All welding shall be done by the manufacturers process to provide full penetration of the welded material. All mounting hardware shall be constructed of Type 304 stainless steel.

2.16 LEVEL CONTROL

A. Furnish level control instruments in accordance with Section 13421.

2.17 CONTROL OPERATION

A. Furnish a control panel in accordance with Sections 13405 and 13413.

2.18 PUMP PERFORMANCE

A. Head losses through the pump are not included in the total pumping heads. Pumping heads and other terms shall be as defined in the Standards of the Hydraulic Institute.

B. Motors must not operate in service factor in any portion of pump operating range.

C. Controls and electrical service for motor are rated higher than the minimum horsepower listed (Refer to related electrical and control drawings and specifications).

2.19 PUMP PROTECTION

A. Provide the following devices associated with protecting the scum pumps (pumps P-421 and P-422).

1. Thermal Switches. Provide a thermal switch capable of detecting overheating per phase of the stator winding.

2. Float Switch. Provide a float switch capable of detecting leakage within the submersible pump's stator housing.

3. Oil Water Sensor. Provide a sensor capable of detecting the presence of water in the submersible pumps oil chamber.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store and protect all equipment in accordance with manufacturer/supplier recommendations and/or instructions in addition to the requirements of Section 01600, Materials and Equipment.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Owner's Representative review.

B. Certification of all factory testing data and results shall be submitted for Owner and Engineer review.

3.3 INSTALLATION

A. Install all equipment in accordance with manufacturer/supplier recommendations and/or instructions.

3.4 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, approved by both the manufacturer's factory representative and the Owner's representative.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Owner's Representative.

3.5 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655, Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

C. Checkout of final installation, start-up, calibration and instruction of operating personnel shall be performed by an authorized representative of the manufacturer. Startup service to be performed in one (1) trip of one (1) day.

3.6 PAINTING TOUCH-UP

A. Touch-up abrasions and other defective areas in items furnished with factory finish, using primers and paints for finish coat equal to that employed for factory coats.

3.7 OPERATING TESTS

After all pump and control systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation. Make adjustments as required to ensure proper functioning of all systems.

Project: Galveston Pirates Beach Wastewater Treatment Plant

Pump Tag Number:	P-411, 412, and 413
Pump Name:	RAS Pumps
Manufacturer and Model Number:	Wilo EMU FA10.22W (curve 1140) or Flygt Concentrator N100 (curve 450) or Flygt NP 3069 (curve 414)

Service Conditions			
Liquid: Sewage Return Activated Sludge			
Flow Rates:	Two Pumps Running:	360 gpm (total flow) @ 10 ft TDH	
	Two Pumps Running:	270 gpm (total flow) @ 8 ft TDH	
	One Pump Running:	180 gpm @ 8.5 ft TDH	
	One Pump Running:	95 gpm @ 7.5 ft TDH	
Fluid Temperature (degrees Fahrenheit):	Max 80 Min 40		
Specific Gravity at 60 degrees F: 1.04		Viscosity at 60 degrees F: Similar to water	
Vapor pressure at 60 degrees F: 0.26 psia			
Abrasive (Y/N): Y	Possible Scale Build Up (Y/N):	Y	
Corrosion Caused By:	Dissolved Hydrogen Sulfide		
Diameter Solids Pump Shall Be Capable of Passing: 3 inch*			
Min. NPSH Available (Ft, Absolute): 32 ft (atmospheric pressure, no submergence)			
Pump Location:	□ Indoor	□ Heated	Min Air Temp: 10 deg F Altitude: 105 ft
	■ Outdoor	■ Unheated	Max Air Temp: 115 deg F
	■ Wet well	□ Dry well	
Electrical Code Classification: Class 1 Div. 1 Group C and D			

Performance Data		
Pump Type:	Submersible Solids Handling	
BEP Conditions:	160 gpm @ 11 ft*	
NPSHr at BEP:	6 ft*	
NPSHr (max):	13 ft*	
Pump Efficiency at Operating Point: Minimum 35%*		
Nominal Pump Speed (full speed):	1150 rpm	
Pump Speed Range:*	575 - 1150 rpm.*	
Shutoff Head:	17.56 ft*	
Run Out Point:	295 gpm at 6 ft* (at full speed rpm)	
Max. Brake HP:	3 BHP*	
Pump Specifications:		
Suction ftg. & size:	4 inch	
Discharge ftg. & size:	4 inch	
Impeller Diameter:	170 mm*	
Type of Seal/Manf./Model:	Tandem Mech. Shaft Seal*	Seal Lubrication: Oil Reservoir*
Type of Lubrication:	Perm. Lubrication*	
Lubrication Method(s):	Oil Filled*	

Materials of Construction:	
Casing:	Cast Iron ASTM-A-48
Stuffing Box Cover:	N/A
Impeller:	Gray Cast Iron Class 30
Shaft:	Stainless Steel
Shaft Sleeve(s):	N/A*
Bearings/Service Life:	L_{10} = 40,000 hrs*
Coupling Guard:	N/A
Guide Rails:	Stainless Steel

Drive Motor Specifications:	
Manufacturer:	*
Enclosure:	Class I Div 1 Group C&D
Rated HP:	3 HP
Motor Efficiency:	95%*
RPM:	1150*
Frame:	*
Phase/Hz/Volts:	3/60/220*

Weights and Measurements:	
Pump and Motor:	lbs.*

Other Details and Information: Installed in a dry pit application.

* Vendor Confirmed or Supplied Information.

Project: Galveston Pirates Beach Wastewater Treatment Plant

Pump Tag Number:	P-421 and 422
Pump Name:	Scum Packaged LS Pumps
Manufacturer:	Wilo or Flygt

Service Conditions			
Liquid: Sewage scum			
Flow Rates:	One Pump Running: 50 gpm @ 6 ft TDH		
Fluid Temperature (degrees Fahrenheit):	Max 80 Min 40		
Specific Gravity at 60 degrees F: 1.04		Viscosity at 60 degrees F: Similar to water	
Vapor pressure at 60 degrees F: 0.26 psia			
Abrasive (Y/N): Y	Possible Scale Build Up (Y/N):	Y	
Corrosion Caused By:	Dissolved Hydrogen Sulfide		
Diameter Solids Pump Shall Be Capable of Passing: 1inch*			
Min. NPSH Available (Ft, Absolute): 32 ft (atmospheric pressure, no submergence)			
Pump Location:	□ Indoor ■ Outdoor ■ Wet well	□ Heated ■ Unheated □ Dry well	Min Air Temp: 10 deg F Altitude: 105 ft Max Air Temp: 115 deg F
Electrical Code Classification: Class 1 Div. 1 Group C and D			

Performance Data		
Pump Type:	Submersible Solids Handling Chopper Style	
BEP Conditions: *		
NPSHr at BEP: ft*		
NPSHr (max): ft*		
Pump Efficiency at Operating Point: Minimum *		
Nominal Pump Speed (full speed):	1800 rpm MAX	
Pump Speed Range:*	rpm.*	
Shutoff Head:	ft*	
Run Out Point:	gpm at ft* (at full speed rpm)	
Max. Brake HP:	5 BHP*	
Pump Specifications:		
Discharge ftg. & size:	4 inch	
Impeller Diameter:	mm*	
Type of Seal/Manf./Model:	Tandem Mech. Shaft Seal*	Seal Lubrication: Oil Reservoir*
Type of Lubrication:	Perm. Lubrication*	
Lubrication Method(s):	Oil Filled*	

Materials of Construction:	
Casing:	Cast Iron ASTM-A-48
Stuffing Box Cover:	N/A
Impeller:	Gray Cast Iron Class 30
Shaft:	Stainless Steel
Shaft Sleeve(s):	N/A*
Bearings/Service Life:	L_{10} = 40,000 hrs*
Coupling Guard:	N/A
Guide Rails:	Stainless Steel

Drive Motor Specifications:	
Manufacturer:	*
Enclosure:	Class I Div 1 Group C&D
Rated HP:	5 HP
Motor Efficiency:	%*
MAX RPM:	1800*
Frame:	*
Phase/Hz/Volts:	3/60/220*

Weights and Measurements:	
Pump and Motor:	lbs.*

Other Details and Information: Package lift station system complete with wet well, guide rails, cable, isolated discharge pressure gauges (if applicable)., discharge connection, and lifting chains (if applicable).

* Vendor Confirmed or Supplied Information.

Project: Galveston Pirates Beach Wastewater Treatment Plant

Pump Tag Number:	P-701
Pump Name:	Jet Mixing Pumps
Manufacturer:	Wilo or Flygt

Service Conditions			
Liquid: Sewage scum			
Flow Rates:	One Pump Running: 732 gpm @ 19 ft TDH		
Fluid Temperature (degrees Fahrenheit):	Max 80 Min 40		
Specific Gravity at 60 degrees F: 1.04		Viscosity at 60 degrees F: Similar to water	
Vapor pressure at 60 degrees F: 0.26 psia			
Abrasive (Y/N): Y	Possible Scale Build Up (Y/N):	Y	
Corrosion Caused By:	Dissolved Hydrogen Sulfide		
Diameter Solids Pump Shall Be Capable of Passing: 1 inch*			
Min. NPSH Available (Ft, Absolute): 32 ft (atmospheric pressure, no submergence)			
Pump Location:	□ Indoor ■ Outdoor ■ Wet well	□ Heated ■ Unheated □ Dry well	Min Air Temp: 10 deg F Altitude: 5 ft Max Air Temp: 115 deg F
Electrical Code Classification: Class 1 Div. 1 Group C and D			

Performance Data			
Pump Type:	Submersible Solids Handling Chopper Style		
BEP Conditions: *			
NPSHr at BEP: ft*			
NPSHr (max): ft*			
Pump Efficiency at Operating Point: Minimum *			
Nominal Pump Speed (full speed):	1800 rpm MAX		
Pump Speed Range:*	rpm.*		
Shutoff Head:	ft*		
Run Out Point:	gpm at ft* (at full speed rpm)		
Max. Brake HP:	7.5 BHP*		
Pump Specifications:			
Discharge ftg. & size:	4 inch		
Impeller Diameter:	mm*		
Type of Seal/Manf./Model:	Tandem Mech. Shaft Seal*	Seal Lubrication: Oil Reservoir*	
Type of Lubrication:	Perm. Lubrication*		
Lubrication Method(s):	Oil Filled*		

Materials of Construction:	
Casing:	Cast Iron ASTM-A-48
Stuffing Box Cover:	N/A
Impeller:	Gray Cast Iron Class 30
Shaft:	Stainless Steel
Shaft Sleeve(s):	N/A*
Bearings/Service Life:	L_{10} = 40,000 hrs*
Coupling Guard:	N/A
Guide Rails:	Stainless Steel

Drive Motor Specifications:	
Manufacturer:	*
Enclosure:	Class I Div 1 Group C&D
Rated HP:	7.5 HP
Motor Efficiency:	%*
MAX RPM:	1800*
Frame:	*
Phase/Hz/Volts:	3/60/220*

Weights and Measurements:	
Pump and Motor:	lbs.*

Other Details and Information: Package lift station system complete with wet well, guide rails, cable, isolated discharge pressure gauges (if applicable)., discharge connection, and lifting chains (if applicable).

* Vendor Confirmed or Supplied Information.

SECTION 11320

INDUCED VORTEX GRIT UNIT

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of two (2) hydraulically induced vortex grit unit. This unit is to be completed in place, installed in the Headworks structure, as indicated on the drawings. The de-gritting unit shall be identified as GRU-211 and GRU-212, and shall include chamber inlet tube, underflow pipe to grit pump suction, controls, and all auxiliary equipment and appurtenances required for a complete and operational system. GRU-211 and GRU-212 shall discharge to grit classifier and grit unit and classifier shall be designed to work together.

B. All equipment specified under this section and Section 11321 – Grit Classifier, shall be designed to operate together and shall be provided by a single manufacturer/supplier.

C. This requirement may include equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be accepted by the Engineer.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300, Submittals, and Section 01340, Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Engineer review.

C. Shop Drawings/Product Data. At a minimum, provide the following:
1. Provide complete descriptive product data, detailed installation drawings, accessories and related information.
2. Any exceptions to the specifications.

D. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730, Operation and Maintenance Data.

E. Submit operating data to show compliance with removal efficiencies specified.

F. Provide a letter of certification signed by an authorized representative of the manufacturer stating that the manufacturer has inspected the installation and verified training of the Owner's operations and maintenance personnel upon completion of the installation. The certification shall state that the equipment has been installed in accordance with the manufacturer's recommendations, is in proper adjustment and operating condition, the manufacturer is prepared to warrant the equipment to perform in full compliance with these specifications, and the equipment is ready to be turned over to the Owner for operation.

1.3 WARRANTY

Provide equipment warranty in accordance with the requirements of Section 01700, Contract Closeout.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. Induced vortex grit unit shall be designed based on the following conditions:

Item	Description
Quantity	2
Designation	GRU-211 and GRU-212
Type	Hydraulically Induced Vortex
Peak Flow (mgd) (each unit)	2.25
Design Flow (mgd) (each unit)	0.75
Upstream Channel Width	2'- 8"
Downstream Channel Width	4'- 0"
Necessary Water Supply (manually controlled each unit)	50 gpm @ 50 psig*

*Note that NPW system has a lower operating pressure of approximately 35 psi. Manufacturer to provide booster pump if this supply pressure is not adequate. Contractor to coordinate all headworks equipment with manufactures so multiple booster pumps are not installed (induced vortex grit unit, grit washer, and screening washer compactor).

B. The de-gritting units shall at a minimum be capable of removing the following at the specified hydraulic peak flow rate, and no decrease in efficiency shall be allowed at flows less than this rate.

1. 95 percent of grit 106 microns in size and larger having a specific gravity of 2.65 at peak flow or 24 MGD
2. At an average flow rate of 0.75 MGD, 95 percent of all grit 75 microns in size and larger having a specific gravity of 2.65.

C. The de-gritting units shall have no more than 1 foot of head loss and shall be capable of removing grit from raw screened waste and depositing it to a storage hopper.

2.2 ACCEPTABLE MANUFACTURERS

A. Provide equipment from the following acceptable manufacturer:

1. Hydro International/Eutek.
2. or Owner approved substitution.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01600, Materials and Equipment.

2.3 QUALITY ASSURANCE

A. All equipment items furnished under this specification shall be furnished by a single supplier who shall be responsible for the adequacy of design.

B. Equipment shall be supplied by a firm that has regularly engaged in the design, fabrication, assembly, testing, start-up and service of grit chambers, as proposed for use in wastewater treatment for a minimum of five (5) years. The manufacturer must have installed and had in satisfactory use a minimum of five (5) installations of similar type, comparable size or larger, and of the approximate capacity as given to the units specified. Submit list with contacts to engineer for review.

C. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume

responsibility for the proper function of all equipment, following installation.

2.4 PRODUCT DESCRIPTION

A. Grit Chamber.
1. Influent shall enter the de-gritting chambers through a piped channel, which shall be capable of isolation though the use of hand gates.
2. Fluidized grit shall exit the de-gritting chambers through a pipe at the bottom of the unit, which shall connect to the grit pump suction line.
3. Flow through the removal chamber shall travel between the inlet and the outlet in such a way that it will provide maximum travel of the liquid for effective grit removal.

B. Access Platform, Railings, Ladder & Odor Control Cover
1. The Grit King® duo will include an access platform with railing and ladder for O&M and inspection access along with odor control covers above the inlet distribution box, common effluent box and both Grit King® units.

C. Control Panel
1. The panel shall contain all timers, VFD, switches, and indicator lights to operate two (2) Grit King® units in either fully automated or manual mode.

D. Spare Parts. Provide spare parts in accordance with requirements of Section 01700, Contract Closeout.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600, Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 INSTALLATION

A. Install all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.3 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, and approved by the manufacturer's factory representative and subject to review by the Owner’s Representative.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer’s factory representative. Contractor shall submit written certification from Manufacturer’s factory representative of proper equipment installation and operation to Owner and Owner’s Representative.

3.4 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655, Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

END OF SECTION

SECTION 11321

GRIT CLASSIFIER

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision and installation of grit classifier and dewatering equipment, including one (1) grit classifier. As indicated on the drawings, this unit shall be installed at the Headworks structure. The units shall be identified as GC-201. Installation shall be completed in place and include appurtenances required for a complete and operational system.

B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be accepted by the Owner's Representative.

C. All equipment specified under this section and Section 11320, Induced Vortex Grit Unit, shall be provided by a single manufacturer/supplier.

D. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume responsibility for the proper function of all equipment, following installation.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300 – Submittals, and Section 01340, Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Owner's Representative review.

C. Shop Drawings/Product Data. At a minimum, provide the following:

1. Provide complete descriptive product data, detailed installation drawings, including, but not limited to, control panel wiring schematic, electrical diagrams, logic diagrams, component description, and control sequence description, accessories and related information.
2. Provide the recommended spare parts for 1 year's normal maintenance with prices, delivery and location of stock (local or factory).

D. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730 – Operation and Maintenance Data.

E. Provide a letter of certification for: installation, operation, training, and factory and field-testing data and results.

1.3 WARRANTY

Provide equipment warranty in accordance with the requirements of Section 01700 - Contract Closeout.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. GC-201 shall be designed based on the following conditions:

Item	Description
Quantity	1
Intermittent Supply Water Required (@ 40 psig*) (gpm)	5
Material	Type 314 SS
Minimum Capacity (ft^3/hr)	41

*Note that NPW system has a lower operating pressure of approximately 35 psi. Manufacturer to provide booster pump if this supply pressure is not adequate. Contractor to coordinate all headworks equipment with manufactures so multiple booster pumps are not installed (induced vortex grit unit, grit washer, and screening washer compactor).

2.2 ACCEPTABLE MANUFACTURERS

A. Provide equipment from the following acceptable manufacturer:

1. Hydro International
2. Wemco.
3. or Owner approved substitution.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01600, Materials and Equipment.

2.3 QUALITY ASSURANCE

A. The equipment shall be supplied by a firm that has regularly engaged in the design, fabrication, assembly, testing, start-up, and service of grit treatment units as proposed for use in wastewater treatment. The manufacturer must have installed and had in satisfactory use a minimum of five installations of similar type, comparable size or larger, and of the approximate capacity as given to the units specified.

B. Provide a letter of certification signed by an authorized representative of the manufacturer stating that the manufacturer has inspected the installation and verified training of the Owner's operations and maintenance personnel upon completion of the installation. The certification shall state that the equipment has been installed in accordance with the manufacturer's recommendations, is in proper adjustment and operating condition, the manufacturer is prepared to warrant the equipment to perform in full compliance with these specifications, and the equipment is ready to be turned over to the Owner for operation.

2.4 PRODUCT DESCRIPTION

A. Grit Classifier Unit Washing Trough and Tank.

1. Grit washer and classifier trough and tank shall be constructed of stainless steel.
2. Trough shall be fitted with a tank of suitable size to contain the grit and water being received.
3. GRU-101 wash water requirement shall be no more than 15 gpm at 50 psig.

B. Grit Classifier Unit Supports. Supports shall be provided in conformance with manufacturer's design requirements and shall be fixed to concrete or steel.

C. Grit Classifier Unit Motor.

1. Motor shall be provided in accordance with the requirements of Section 16222, AC Electric Motors – 100HP and Below, and shall not be more than 1HP.

D. Grit Classifier Unit Controls.

1. Provide NEMA 4X, 316 stainless steel control panel rated for outdoor use in accordance with Section 13413, Control Panels, for the operation of GRU-101.
2. Provide elapsed run time meter for GRU-101 motor. Elapsed run time meter shall be 6-digit, non-resettable, sealed against dirt and moisture, 120 VAC, and shall provide indication of unit run time in hours with 1/10 hour increments.
3. GRU-101 shall be controlled through a Local/Off/Remote switch, which shall be located on the control panel.
4. Controls shall be by relays and timers to provide function described in Specification 13405, Control System Operation
5. Indicating lights for unit on and off shall be furnished on the control panel.
6. Provide single power disconnect and combination motor starter.
7. Provide an unpowered (dry) contact for remote monitoring of the motor status (on/off).

E. Spare Parts. Provide spare parts as recommended in Part 1.2 Subpart C.3 and in accordance with requirements of Section 01700, Contract Closeout.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600, Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Owner's Representative review.

B. Certification of all factory testing data and results shall be submitted for Owner and Owner's Representative review.

3.3 INSTALLATION

Install all equipment in full accordance with manufacturer/supplier recommendations and/or instructions. Provide access platform to inspect and operate GC-231 and 232. Contractor to coordinate with equipment manufacturer.

3.4 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by the both the manufacturer's factory representative and the Owner's Representative.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Contractor shall submit written certification from Manufacturer's factory representative of proper equipment installation and operation to Owner and Owner's Representative.

3.5 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655, Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

END OF SECTION

SECTION 11333

SCREENINGS COMPACTOR-WASHER

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of all equipment, controls, appurtenances, installation and testing necessary for two (2) screenings compactor-washers. As indicated on the drawings, these units shall be installed at the headworks, and shall be identified as WC-201 and WC-202. The compactor-washers shall each consist of an entrance hopper, a shafted spiral auger, a wash-deluge zone, a compaction zone, a discharge tube, and accessories to be installed as indicated on the drawings and as specified herein. Compacted and washed screenings shall discharge through the discharge tube into the headworks structure's hopper, and subsequently into a dumpster destined for the landfill. Coordinate with rotary drum screens under Section 11334 – Externally Fed Rotary Drum Screen.

B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be approved by the Engineer.

C. All equipment specified under this section and Section 11334 - Externally Fed Rotary Drum Screen, shall be provided by a single manufacturer/supplier.

D. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume responsibility for the proper function of all equipment, following installation.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01330, Submittal Procedures, and Section 01340, Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Engineer review.

C. Shop Drawings/Product Data. At a minimum, provide the following:

1. Complete assembly drawings of mechanical fine screen system components, including materials of construction, dimensions and location of each component.
2. Equipment layout drawings.
3. Product information on the unit and its components.
4. Control details and electrical schematic diagrams, including details on circuit breakers, motor starters, limit switches, and other electrical components pertinent to proper functioning of the equipment.
5. Performance data including, but not limited to, motor data, gear reducers, etc.
6. Recommended spare parts for one year's normal maintenance with prices, delivery and location of stock (local or factory).
7. List of any exceptions or deviations, with reasons and calculations supporting such exceptions or deviations from specifications.

D. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01770, Closeout Procedures.

E. Provide a letter of certification for: installation, operation, training, and factory and field testing data and results.

1.3 WARRANTY

Provide equipment warranty in accordance with the requirements of Section 01770, Closeout Procedures.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. Compactor Type. Compactor-washer shall be capable of processing a minimum of 70 cubic feet per hour of screenings. The dewatered screenings shall have a minimum weight reduction of 60-70 percent and shall be discharged above the floor into the discharge hopper.

B. Washer Type. Wash port manifold shall be integrated into the housing, with at least one connection at the washing section and one connection at each collection trough. All wash water connections shall be designed to accept a ½-inch to 1-inch NPW line from the plant's NPW system. Spent wash water shall be collected and drained. Wash water requirement shall not exceed 25 gpm or 50 psig. Note that NPW system has a lower operating pressure of approximately 35 psi. Manufacturer to provide booster pump if this supply pressure is not adequate. Contractor to coordinate all headworks equipment with manufactures so multiple booster pumps are not installed (induced vortex grit unit, grit classifier, and screening washer compactor).

C. Materials.

1. All welded fabrications shall be made from 316 stainless steel. Welded areas are to be pickled.
2. Select power transmission parts may be made from cast iron; however, they shall conform to coating requirements as specified in Section 09928, Protective Coatings for Wastewater Systems.
3. Motor Gearbox assembly components shall be coated per the requirements specified in Section 09928, Protective Coatings for Wastewater Systems.
4. Parts not covered above shall be made from UHMW polyethylene.

D. Operation. Compactor-washer shall be designed for continuous operation, requiring no operator supervision. Operation shall be based on the run time of the associated screens. Compactor-washer shall have the ability to clear blocking automatically: if current monitoring relay senses high load condition, the screw shall stop and a clearing cycle shall be initiated.

2.2 ACCEPTABLE MANUFACTURERS

A. Provide equipment from one of the following acceptable manufacturers:

1. Lakeside Equipment Corporation
2. Hubler
3. Waste-Tech/Kusters Zima.
4. Vulcan
5. Or approved substitution.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01600, Material & Equipment.

2.3 QUALITY ASSURANCE

A. Manufacturer shall have at least 5 years experience in manufacture, operation, and servicing of equipment of type, size, quality, performance, and reliability equivalent to that specified.

B. All materials used shall be new, of high grade, and with properties best suited to this working environment.

2.4 PRODUCT DESCRIPTION

A. Compactor Housing. The compactor housing shall be fabricated from 1/8-inch minimum thickness stainless steel. Housing shall include two trough openings for screenings deposit from MFS-201 and 202 as well as a hatch opening with hinged cover for screenings deposit from BS-203. The trough openings shall be located behind MFS-201 and 202 respectively, as indicated on the drawings. The hatch opening shall be located at the drive end of SC-222, closest to BS-203 and furthest from the discharge pipe, as indicated on the drawings. A level mounting flange shall be provided around each trough for the transitional hoppers that direct the screenings into the troughs. The hoppers shall be fabricated from 18-gauge minimum thickness 316 stainless steel. The housing shall house the shafted screw and shall include, at minimum, one wash water connection in the washing zone and one connection in each screenings trough.

B. Auger. The shafted screw shall transport the collected screenings into the main washing zone and shall force the compacted screenings out the discharge pipe. The shafted screw shall be sized to receive screenings from the hatch and each trough, as indicated on the drawings. The shafted screw and flights shall be fabricated from 1/5-inch minimum thickness stainless steel. The screw shall include a minimum 6-inch flight pitch in the hatch and trough areas and washing zone and a minimum 4-inch flight pitch in the compaction zone. A stainless steel backed brush with nylon bristles shall be attached to the shafted screw with stainless steel holder clips and fasteners for the full length of the washing zone.

C. Drive Assembly.

1. The drive unit shall include a gear and motor rated for continuous duty and shall be selected to match the requirements of the particular screen. The drive motor shall be no more than 5 hp, and shall be a totally enclosed fan cooled (TEFC) unit designed for application in a Class 1, Division 2 area. The motor shall be a constant speed unit rotating at no more than 1800 rpm, and shall be powered by 460 VAC, 60 Hz, 3 phase power. Motor shall be as specified in Section 16222, AC Electric Motors – 100HP and Below.
2. The drive unit shall be direct coupled to the screen drive shaft through the gear box. The gear box housing shall be constructed from ASTM A-48, Class 30 cast iron.
3. The gear box shall be designed for AGMA Class II.

D. Discharge Pipe. The discharge pipe shall be made of stainless steel and shall be connected to the screenings washer by flange.

E. Controls.

1. Controls shall be provided by compactor-washer manufacturer and coordinated with continuous cleaning rotary drum screen controls.
2. Refer to specification Sections 13405, Control System Operation, and 13413, Control Panels, for additional information and requirements.
3. Manufacturer shall include an emergency stop pull cord.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Installation shall be accomplished in strict conformance with the compactor-washer manufacturer's installation instructions. Installation shall utilize standard torque values and shall secure compactor-washer in position with a neat appearance. Plumbing connection shall be a standard ½ -inch NPT pipe with male threads for supply and a 3-inch female NPT for drainage. Plumbing shall be completed by a qualified individual, in accordance with all prevailing local and national plumbing regulations.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Engineer review. Certification of all factory testing data and results shall be submitted for Owner and Engineer review.

3.3 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by the both the manufacturer's factory representative and the Owner's Inspector.

B. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Engineer.

3.4 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655, Starting Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

END OF SECTION

SECTION 11334

EXTERNALLY FED ROTARY DRUM SCREEN

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of two (2) externally fed rotary drum screen units and one (1) manual bar screen. These units are to be completed in place, installed in the Headworks structure, as indicated on the drawings. The screening units shall be identified as MFS-201 and MFS-202. The manual bar screen shall be identified as MS-203. MFS201 and MFS 202 shall include rotary screens, tanks assembly with headbox and overflow, doctor blade assembly, spray wash system, discharge chute, dive assembly, controls, and all auxiliary equipment and appurtenances required for a complete and operational system.

B. The rotary drum screen shall be designed to screen a pumped flow mixture of liquids/solids and discharge to a collection container as shown on the Drawings and described in the Specifications.

C. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be accepted by the Owner's Representative.

D. All equipment specified under this section shall be provided by a single manufacturer/supplier.

E. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume responsibility for the proper function of all equipment, following installation.

F. Related Sections

1. General Conditions, Supplementary Conditions, and General Requirements sections apply to work of this Section.

1.2 REFERENCES

A. American Institute of Steel Construction (AISC)

B. American Society of Testing and Materials (ASTM)

C. American Welding Society (AWS)

D. Steel Structures Painting Council (SSPC)

E. American Gear Manufacturers Association (AGMA)

1.3 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300 – Submittals.

B. Submittals shall include a complete descriptive product data for all equipment to be provided, including but not limited to;
   1. Fabrication and installation drawings,
   2. Electrical, instrumentation and controls component requirements
   3. List showing materials of construction of all components
   4. Pertinent design calculations, and any other related information necessary to facilitate Owner and Owner's Representative review.
   5. Complete list of deviations from the drawings and specifications.

C. Shop Drawings/Product Data. At a minimum, provide the following:
   1. Provide complete descriptive product data, detailed installation drawings, including, but not limited to, control panel wiring schematic, electrical diagrams, logic diagrams, component description, and control sequence description, accessories and related information.
   2. Provide the recommended spare parts for 1 year's normal maintenance with prices, delivery and location of stock (local or factory).

D. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730 – Operation and Maintenance Data.

E. Provide a letter of certification for: installation, operation, training, and factory and field testing data and results.

1.4 WARRANTY

A. Provide equipment warranty in accordance with the requirements of Section 01700 – Contract Closeout.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA – Rotary Drum Screen

Description	**Phase I**	**Phase II***	**Phase III**
Average Daily Flow (gpm)	347.22	694.44	1042
Peak Flow (gpm)	1041.66	2083.32	3126
Screen Cylinder Type	Wedge-Wire	Wedge-Wire	Wedge-Wire
Maximum Screen Opening Spacing (in)	0.1	0.1	0.1
Nominal Screening Drum Diameter (in)	25	25	25
Nominal Screening Drum Length (in)	By Manfr.	By Manfr.	By Manfr.
Maximum Envelope (ft)	8.5'Lx6'Dx6'H	-	-

*Screens provided by manufacturer shall provide full peak flow redundancy through Phase II. Both screens may be utilized as duty screens to accommodate Phase III peak flow.

2.2 DESIGN CRITERIA – Manual Bar Screen

Description	**Phase III**
Average Daily Flow (gpm)	1042
Peak Flow (gpm)	3126
Dimensions	See Drawings
Maximum Screen Bar Spacing (in)	3.0

2.3 ACCEPTABLE MANUFACTURERS

A. Provide equipment from the following acceptable manufacturer:
   1. Lakeside Equipment Corporation
   2. JWC Environmental
   3. Or Owner approved substitution

2.4 QUALITY ASSURANCE

A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these Specifications that a single manufacturer shall supply all equipment called for under this Section. The equipment manufacturer shall, in addition to the CONTRACTOR, assume the responsibility for proper installation and functioning of the equipment.

B. The Contract Documents represent the minimum acceptable standards for the screening equipment for this project. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. If not named, equipment which is a "standard product" with that manufacturer shall be modified, redesigned from the standard mode, and shall be furnished with special features, accessories, materials of construction or finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of the specification.

2.5 ROTARY STRAINER SCREEN

A. Tank/Headbox Assembly

1. The tank/headbox assembly shall be fully enclosed and constructed of a minimum material thickness 11 gauge type 304 stainless steel with a flanged discharge pipe . The tank assembly shall include a 12-inch flanged inlet connection to the headbox. The headbox shall be equipped with two (2) 6-inch cleanout ports located on opposite sides of the tank with removable plugs.

2. The tank assembly shall include hinged inspection covers for the inlet side and discharge. Covers shall be secured with latches. Bolted access ports shall be provided on each side of the tank to access the inside of the screen cylinder and spray bar.

3. The headbox shall include an adjustable overflow weir designed to overflow 100% of the influent capacity without overflowing the top of the tank.

4. The headbox shall have a 4-inch flanged connection located on the top of the unit to be utilized for odor control.

B. Screen Cylinder

1. The screen cylinder will be constructed of type 304 stainless steel and consist of a continually helical wound spiral peripheral wedge-shaped wire.

2. Each end of the screen cylinder will be supported by a hub assembly welded to the ends of the cylinder. Support rings shall be welded to the inside of the cylinder and evenly spaced along the length to provide structural integrity. Each hub assembly shall have a bolted-on stub shaft supported by self-aligning, pillow block bearings with grease fitting. The bearings shall be mounted on a support base welded to the tank assembly.

3. A bolted UHMWPE seal shall be provided to seal the cylinder ends on the inlet side to prevent short circuiting of the flow. The seal will have a close tolerance fit to the extended flange of the rotating cylinder hub.

4. The cylinder shall include an internal baffle of minimum 18 gauge type 304 stainless steel along the length of the cylinder to prevent splashing.

C. Discharge Doctor Blade Assembly and Blade Cleaner

1. A doctor blade assembly shall be provided to remove collected solids from the outside surface of the screen cylinder for discharge. The doctor blade holder assembly shall be constructed of type 304 stainless steel.

2. The doctor blade shall be constructed of either monel or phosphorus bronze. The doctor blade shall be designed to be field replaceable with minimal effort. An adjustable locking compression assembly shall be provided to maintain pressure of the doctor blade against the cylindrical screen. The pressure will be preset prior to shipment from the factory. The manufacturer shall verify and certify the doctor blade is applying appropriate pressure for optimal performance prior to project closeout.

3. An automatic doctor blade cleaner assembly will be furnished and mounted above the solids discharge doctor blade to aid removal of solids from the primary blade. The cleaning action will be continuous and automatic whenever the machine is in operation.
    a. The cleaner blade will be of bronze construction with the blade holder and pivot end bearing fabricated of type 304 stainless steel. An adjustable tension rod will hold the blade cleaner against the discharge doctor blade. The blade cleaner shall be hinged to allow for cleaning or replacement.

D. Spray System

1. An internal spray system shall be provided to assist in cleaning. The spray header shall be fabricated of type 304 stainless steel. A minimum of twenty-two (22) replaceable spray nozzles with stainless steel quick clamps will be installed to deliver appropriate flow and pressure required to adequately clean the cylinder and maintain proper operation. Spray nozzles shall be positioned not more than 6 inches from the inside surface of the cylinder. The spray header shall include quick disconnects to allow for easy removal of the spray header through the access ports on the side of the tank assembly.

2. A 1-inch solenoid valve with stainless-steel body suitable for 120 VAC operation shall be provided. The solenoid valves shall be normally closed and rated for up to 100 psig. The solenoid valve shall be slow close type to minimize water hammer. Solenoid valve electrical connectors shall be a metallic design. Solenoid valves that use plastic connectors will not be acceptable for this project.

3. An external 1-inch NPT coupling shall be furnished for connection of the customer supplied water source.

E. Solids Discharge

1. Solids shall discharge direction to compactor washer. Filter manufacturer shall provide Compactor-Washer in accordance with Section 11333 – Screenings Compactor-Washer.

F. General Motor Provisions.

1. Provide in accordance with Section 16222 - AC Electric Motors – 100 HP and Below, and as specified herein.
2. The motor shall be AC induction type, inverter duty rated. The motor shall be 3 phase, 460 volt and mounted to the gear reducer. Motor shall be 3HP maximum.

G. Drive Assembly

1. The screen cylinder shall be driven by a shaft mounted geared motor. The geared motor shall have a minimum service factor of 1.0 equivalent to an AGMA Class I rating.

2.6 MANUAL BAR SCREEN

A. A manual bar screen shall be furnished as part of the screening system.

B. Tank, bars, and all supplied hardware shall be fabricated from 316 stainless steel.

2.7 CONTROL PANEL

A. A rotary drum screen main control panel shall be furnished, completely pre-wired and tested, requiring only mounting and connection to external wiring by an electrical contractor in the field. Control panel shall include all equipment required to control the bar screen as specified herein and in Section 13405 - Control System Operation.

B. Control Panel(s) shall be NEMA 4X stainless steel and shall include a main, lockable, flange mounted disconnect. The panel shall be constructed by a UL certified control panel build facility and shall be supported by the appropriate UL 508A labeling.

C. Control panel enclosure shall be sized as required to house equipment and shall be suitable for mounting or mounting to strut-type supports. Enclosure shall be rated NEMA 4X 316 SSTL. A separate local control panel rated NEMA 4X 316 SSTL shall be provided.

D. Drum screen shall be controlled by relays based off of level sensor and timer inputs.

E. Local control panel shall include all equipment necessary as stated in Section 13405 - Control System Operation.

F. Door mounted indication lights, non-metallic, NEMA 4X, shall be provided to indicate running status, mode status, and alarm status of the bar screen. Legend plates shall be provided.

G. Refer to specification Sections 13405 - Control System Operation, and 13413 - Control Panels, for additional information and requirements.

H. Provide spare parts in accordance with requirements of Section 01700 - Contract Closeout.

I. A NEMA 4X local e-stop mounted next to the screen shall be supplied with Polycarbonate enclosure.

2.8 ANCHOR BOLTS

A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Bolts, washers and hex nuts shall be 304 stainless steel unless noted otherwise. Anchor bolts shall be expansion-type or epoxy-type stainless steel.

B. Anchor bolts shall be set by the CONTRACTOR. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

2.9 SHOP SURFACE PREPARATION AND PAINTING

A. Electric motors, speed reducers, and other self-contained or enclosed components shall have manufacturer's standard enamel finish.

B. Clean and passivate all stainless-steel surfaces and provide glass bead blast or chemically treat all stainless steel to a uniform finish.

2.10 SOURCE QUALITY CONTROL

A. All structural stainless-steel components shall be fabricated in the United States and shall conform to the requirements of "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" published by the American Institute of Steel Construction.

B. All parts and assemblies shall be fabricated from sheets and plates of AISI Type 316 stainless steel conforming to AISI 316 and ASTM A666, unless noted otherwise. All rolled or extruded shapes shall be fabricated to conform to ASTM A276. All tubular products and fittings shall be fabricated to conform to ASTM A269, A351 and A403.

C. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross section equal to or greater than the parent metal does. All butt welds shall be full penetration type to the interior surface. Provide gas shielding to interior and exterior of the joint.

D. Welding of the screen components shall be in accordance with the latest edition of the American Welding Society (AWS) standards. Field welding of stainless steel will not be permitted.

E. Bolts, nuts and washers shall be AISI 316 stainless steel furnished in accordance with ASTM A193.

F. All surfaces that are specified to be machined shall be designed and fabricated to provide a runout of not more than 0.005 inches and concentricity to within 0.005 inches.

PART 3 - EXECUTION

3.01 FIELD PREPARATION AND PAINTING

A. Finish field preparation and painting shall be performed as specified in Section 09928.

B. The CONTRACTOR shall touch-up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the job site.

C. The CONTRACTOR shall supply paint for field touch-up and field painting.

D. The CONTRACTOR shall finish paint electrical motors, speed reducers, and other self-contained or enclosed components with oil-resistance enamel.

E. Prior to assembly the CONTRACTOR shall coat all stainless-steel bolts and nut threads with a non-seizing compound.

3.02 INSTALLATION

A. The manufacturer shall schedule one (1) trip to the project site for equipment start-up assistance as noted in paragraph 3.02.B. for the CONTRACTOR and for operating training as noted in paragraph 3.03.C. for OWNER personnel.

B. After the CONTRACTOR has installed the unit and the equipment is capable of being operated, the equipment manufacturer shall furnish a qualified representative for a minimum of two (2) days (up to 16 hours) to inspect the equipment and to supervise field-testing and start-up for the CONTRACTOR.

C. After the equipment has been placed into operation, the manufacturer's representative shall make all final adjustments for proper operation.

3.03 SHOP TESTING

A. Prior to shipment of the equipment the screen shall be operated for a minimum of one (1) hour at the fabrication location with the specific drive motor that will be furnished for the project.

B. A certified shop test report shall be submitted to the ENGINEER.

3.04 OPERATOR TRAINING

A. Provide operator training for OWNER'S personnel after system is operational. Training will take place while manufacturer's representative is at the job site for inspection.

END SECTION 11330

SECTION 11377

AERATION DIFFUSER SYSTEMS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the design, manufacture, installation and start-up of diffuser systems. The diffusers systems shall be installed in an activated sludge system. The diffuser systems shall be installed in two basins consisting of four zones each. The first zone shall be a selector zone, nominally anaerobic, being intermittently mixed by course bubble diffusers. The second through fourth zones shall be aerobic, with fine bubble diffusers in tapered configuration. Systems shall include diffusers and appurtenances with all related piping, supports, valves, and fittings. If the diffuser system in not capable of withstanding the possible air temperatures delivered by the blower system, additional stainless-steel air piping shall be provided by the diffuser manufacture to reduce the air temperature to an acceptable level.

1.2 DEFINITIONS

A. Diffuser Unit. Fabricated unit including diffuser support frame and flexible membrane.

B. Air Drop Pipe. Vertical piping section from out-of-basin header stub to in-basin aeration system.

C. Air Manifold Piping. Air distribution piping from drop pipe to air distribution headers.

D. Air Header Distribution Piping. Air distribution piping from air manifold and diffuser assemblies.

E. Air Header Piping. Out-of-basin air distribution piping from the blower building to the header stubs.

F. Maximum Pressure. Pressure in blower manifold piping at the specified airflow rate.

1.3 SYSTEM DESCRIPTION

A. Design Requirements.

1. Design in-basin air piping and diffusers to diffuse air throughout the aeration tank(s) in accordance with the specifications and noted in the Drawings.
2. Aeration system manufacturer shall provide aeration basin system design complete with diffuser blanks incorporated into the design.
3. Aeration system manufacturer shall provide fine bubble diffuser design for aeration zones and course bubble diffuser for selector zone.
4. Contractor to utilize single diffuser system manufacturer for both aeration zones and selector zones.
5. Design each diffuser assembly to provide uniform air release over the specified airflow range.

1.4 SUBMITTALS

A. General. Contractor shall provide all submittals in accordance with the requirements of Section 01300 - Submittals, and Section 01340 - Shop Drawings, Product Data and Samples. The engineering submittal package shall be provided in sufficient detail and scope to confirm compliance with the requirements of this section. Submittals shall be complete for all required components. Partial submittals will not be accepted.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01630, Product Options and Substitutions.

C. Shop Drawings. Detailed layout drawings for in-basin aeration components. Layout drawings shall include:

1. Layout and configuration of aeration system.
2. Detail drawings of diffuser assemblies showing components, method of construction, and attachment mechanism to air header distribution piping.
3. Detail drawings of all piping connections including drop to manifold, manifold to header and inline connections for manifold and headers.
4. Detail drawings of pipe support components.

5. Air transfer calculations

6. Heat exchange calculations

D. Product Data.

1. Detailed listing of materials and materials of construction.
2. Product literature.

E. Installation Instructions.

1. Installation requirements and guidelines for all proposed equipment shall be provided.
2. Information on the aeration system shall include but not be limited to:
   a. Diffuser unit assembly.
   b. Diffuser assembly attachment.
   c. Diffuser membrane replacement instructions.
   d. Piping support components.

F. Operation and Maintenance Data.

1. Operations and maintenance data for all proposed equipment shall be provided in accordance with Section 01730, Operation and Maintenance Data.
2. Information on the aeration system shall include but not be limited to:
   a. Diffuser assembly cleaning procedures.
   b. Maintenance and replacement data.

1.5 WARRANTY

A. Provide equipment warranty in accordance with the requirements of Section 01700 – Contract Closeout.

B. The manufacturer of the equipment shall warrant for two years that the equipment will be free from defects in design, material, and workmanship.

C. In the event a component fails to perform as specified or is proven defective in service during the warranty period, excluding items of supply normally expended during operation, the manufacturer shall provide a replacement part without cost to the Owner, and the Contractor shall install the component without cost to Owner. This warranty shall be valid only if the product is properly serviced and operated under normal conditions and in accordance with the manufacturer's instructions.

PART 2 - P R O D U C T S

2.1 DESIGN AND PERFORMANCE REQUIREMENTS

A. The aeration basin system design criteria are as follows:

1. Aeration Basin Configuration: Each aeration basin will have an anaerobic selector zone with intermittent coarse bubble diffusion mixing. Each aeration basin will have three aerated zones with fine bubble diffusers.

2. Aeration Basins (fine bubble w/ coarse bubble mixing zone)

a. Number of Basins	2
Number of Treatment Zones per basin	4 (1 anaerobic selector zone with coarse bubble diffusers, intermittently aerated for mixing; 3 aeration zones with fine bubble diffusers)
b. Number of Drops per Basin	4 (1 grid of diffusers per zone)
c. Basin and Zone Dimensions (See attached drawing).	
d. SWD, ft	22.32 (design flow)

3. Design aeration basin system to transfer not less than the following pounds of oxygen per day in clean water at 14.7 PSI, 20°C and zero dissolved oxygen at the specified submergence, air rate and pressure. The aeration diffusers system including the piping shall be capable of delivering 150% of the design air flow (total air both basins in service).

Diffuser & System Properties	Design
O2 Required (SOTR) (Total-lbs-O2/day - excluding selector)	2,060
Volumetric Air Rate (SCFM Total - excluding selector)	600
Operational Pressure at top of Dropleg (psig)	10.6*
Diffuser Submergence (ft)	21*
Volumetric Air Rate (SCFM Total to Basin Course Bubble grids) SCFM/1000 Cu. Ft.	20

* Value confirmed by vendor

Table 11377-01

4. Aeration Basin Diffuser Layout. The system shall be a tapered aeration system but shall be capable of providing airflow rate of 0.12 scfm per square foot in zones 1, 2 & 3 for mixing purposes per TCEQ. Operationally the diffusers should be able to provide down to 0.05 scfm/sq ft to match minimum mixing criteria as described in EPA fine pore aeration design manual. Obtain required diffuser zone densities by installing blanks in diffuser system.

Aeration Basin Diffuser Layout	Minimum Allowable Diffuser Density (Diffuser SF / Zone SF)
Total / Zone 1 (ft^2/ft^2)	7.65%
Total / Zone 2 & 3 (ft^2/ft^2)	4.95%

Table 11377-02

5. Course bubble diffusers shall be capable of intermittant operation, with design provisions that will prevent clogging by sludge when air flow is turned off.

6. Diffuser Layout.: The Aeration Basin fine bubble diffusers shall be arranged in a tapered pattern, with less diffusers in the final zone and more in the initial zone.

7. MANUFACTURERS

   a. Environmental Dynamics, Inc.

   b. ITT Sanitaire, Inc.

   c. Stamford Scientific, Inc. (SSI)

   d. Approved substitution.

8. Minimum Transfer Efficiency

   a. Minimum clean water transfer efficiency at standard conditions (SOTE) at 20 feet submergence shall be 40 percent (40.0%). Provide test data demonstrating compliance with SOTE requirement, at various air flows per diffuser, including the range of airflows per diffuser between 0.5 scfm/diffuser and 15 scfm/diffuser. Vendor to provide calculated SOTR value at vendor's demonstrated transfer efficiency.

2.2 QUALITY ASSURANCE

A. The Contractor shall provide evidence to the Owner's Representative that the manufacturer has a minimum of five (5) years' experience, within the last seven (7) years, in the design, manufacture, and supervision of installation of equipment of the type required under this Specification.

B. The Contractor shall provide evidence to the Owner's Representative that equipment which was designed and manufactured by the manufacturer of choice, and which is similar to the equipment required under this Specification, has been in continuous and successful operation in at least five (5) separate facilities for the past five (5) years.

C. The Contractor shall require that the manufacturer of the Aeration Diffuser Systems be responsible for the integration and compatibility of all equipment components provided under this Specification.

2.3 MATERIALS, FABRICATION AND FINISHING

A. Air Drop Pipe and Air Header Manifold

1. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778.
2. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.
3. Welds and Welding Procedure.
    a. Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal.
    b. Provide full penetration butt welds to the interior surface with gas shielding of interior and exterior of joint.
    c. Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.
4. Manifold piping shall be a minimum of schedule 40 PVC
5. Provide schedule 10S 304 stainless steel clamp adapter to convert from a metal drop pipe (drop pipe by Contractor) to underwater UPVC piping. Include flex coupling to avoid difficulties in installation and to absorb any minor vibration from the system.
6. Furnish manifold and header supports for each manifold and header. Manifold supports shall be designed for the maximum anticipated bending moments and uplift forces. All components shall be of 304 stainless steel or 304L. Header supports shall allow for vertical adjustment and leveling of the diffuser grid to within 0.25 inches of a common horizontal plane.
7. No worm clamps shall be used.
8. Attach supports to concrete basin floor by means of mechanical anchors. Adhesive anchors will not be accepted.
9. All nuts, bolts and washers shall be 304 stainless steel and shall be furnished by the manufacturer.
10. Corrosion Protection and Finishing. Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:
    a. Pre-clean all outside weld areas to remove weld splatter with stainless steel brushes and/or deburring and finish grinding wheels.
    b. Finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

2.4 AERATION SYSTEM COMPONENTS

A. Aeration System

1. The aeration system components for each aeration system (droplegs, manifolds, diffuser assembly, supports and anchors, and all other components required for a complete aeration system) shall be from a single manufacturer providing single source responsibility for the system. The manufacturer shall be responsible for all system design including, but not limited to, sizing of pipes (per TCEQ chapter 217), and support spacing.

B. Droplegs. Provide a schedule 10S 304 stainless steel clamp adapter to convert from a metal drop pipe (drop pipe by Contractor) to underwater UPVC piping.

1. Provide a band clamp coupling with gasket for the lower dropleg to manifold connection.

C. Manifolds. Provide PVC/steel manifolds for connection to the air distribution headers.

1. Fabricate manifolds with fixed threaded union or flanged joints for connection to the air distributors.
2. Design manifold, distributor connections and supports to resist thrust generated by expansion/contraction of the air distributors over a temperature range of 125°F.
3. Support each manifold in the B-Stage Basins with a minimum of two supports and each manifold in the Aeration Basins with a minimum of eight supports. The supports shall be capable of withstanding the buoyant force of the manifold in the B-Stage Basins and the combined buoyant force of the manifold and the force exerted by the nozzle mixing system as indicated in the required Computational Fluid Dynamics (CFD) modeling detailed in Section 11215 – Digester Sludge Mixing System.
4. Connect manifolds with fixed threaded union or flanged joints to prevent rotation or blow apart.

D. Diffuser Assembly.

1. Fine Bubble Zones

a. Each diffuser assembly shall consist of a PTFE coated EPDM porous membrane disc diffuser element, provisions for connection to the diffuser holder installed on the air distribution piping, and a gasket to provide the required sealing.

b. The diffuser units shall be fully capable of operating under continuous or intermittent conditions and shall be designed with check valve capabilities to prevent entry of sludge into the diffuser unit or air piping on air shutdown or interruption of air supply.

c. The diffusers shall be designed to withstand periodic cleaning using a method detailed by the manufacturer which shall include periodic flexing by increasing the air flow rate.

2. Anaerobic Selector Zones

a. Each diffuser assembly shall consist of an EPDM diaphragm disc diffuser element with an ABS body, bubblecap, provisions for connection to the diffuser holder installed on the air distribution piping, and a gasket to provide the required sealing.

b. The diffuser units shall be fully capable of operating under continuous or intermittent conditions and shall be designed with check valve capabilities to prevent entry of sludge into the diffuser unit or air piping on air shutdown or interruption of air supply.

c. The diffusers shall be designed to withstand periodic cleaning using a method detailed by the manufacturer.

E. Supports.

1. Aeration Zones. Provide each section of manifold and air distributor with a minimum of two (2) supports.

a. Limit maximum support spacing to 8 feet.
b. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125° F and to minimize stress build up in the piping system.
c. Design supports to be adjustable without removing the air distributor from the support.
d. Design supports to allow for complete removal from the tank to facilitate installation of additional headers and in-tank maintenance.

2. Anaerobic Zones

a. The supports shall be evenly spaced with at least one support on each side of the manifolds.
b. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125° – 225° F and to minimize stress build up in the piping system.
c. Design supports to be adjustable without removing the air distributor from the support.

d. Design supports to allow for complete removal from the tank to facilitate installation of additional headers and in-tank maintenance.

F. Anchor Bolts.

1. Design anchor bolts for embedment in 4000 psi concrete with a pullout safety factor of 4.
2. Provide a mechanical 304 stainless steel expansion type anchor bolt system.

G. Liquid Purge System. Diffuser Manufacturer shall provide adequately sized purge connections on each submerged diffuser grid header. Purge connection shall be individually routed to a discharge valve at the end of the grid lateral.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600 – Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Owner's Representative review.

B. Certification of all factory testing data and results shall be submitted for Owner and Owner's Representative review.

3.3 INSTALLATION

A. Contractor shall furnish, inspect, store, and install aeration system components in accordance with manufacturer's written instructions and approved submittals.

B. Diffuser assemblies on a common grid shall be installed within an elevation tolerance of ±1/2 inches.

C. Contractor shall provide all air header piping, wall sleeves with seals, and concrete pedestals as necessary to complete the system.

D. Contractor shall be responsible for cleanliness of piping and shall manually clean pipe, or air or water flush piping as required.

3.4 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by the both the manufacturer's factory representative and the Owner's Representative.

3.5 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655 – Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661 – Instruction of Operation and Maintenance Personnel.

C. Provide a manufacturer's authorized Field Service Engineer for one (1) trip, one (1) day of Installation Inspection and Commissioning and Start-Up Assistance of the equipment furnished on this project.

D. Provide a manufacturer's authorized Field Service Engineer for one (1) trip, one (1) day of Operator training on the equipment furnished on this project. Training will cover Installation, Operation and Maintenance instructions, as well as Troubleshooting and Preventative Maintenance. This is a separate trip than that described in 3.5.C above.

E. Provide a manufacturer's authorized Field Service Engineer for one (1) trip, one (1) day for a follow-up site visit when sufficient biogas is being produced.

After installation is completed, the Contractor shall perform the following field tests in the presence of the Owner's Representative, a factory representative and the Owner.

F. Fill the reactor to the bottom of the diffuser assemblies.

G. Adjust the pipe supports and diffuser assemblies such that all diffuser units are installed within ±1/2 inches of the design diffuser elevation.

H. Fill the reactor to a level of 2 feet above the top of the diffusers.

I. Release air to the system and inspect the system for air leaks at all piping or diffuser connections.

J. Check all diffusers for damage that may have occurred during the installation.

K. Adjust any piping or diffusers that show leaks or disproportionate amount of airflow.

L. Operate the blowers at the design air rate and observe air release and air distribution patterns.

M. All water, air, power and labor associated with testing and adjustment of diffuser assemblies are to be supplied by Contractor.

N. A manufacturer's representative shall be present at the job site to inspect the installation of the equipment, start-up the system, and train operations and maintenance personnel on the supplied equipment. The representative shall provide written certification that the equipment was installed by the contractor according to the manufacturer's instructions.

O. Services including a total of one (1) trip with a total of three (3) days onsite shall be provided.

END OF SECTION

SECTION 11380

AERATION BLOWERS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of the Aeration Blowers B-301, and B-302. Blowers B-301, and B-302 shall be located in the blower building. All aeration blowers shall be of the rotary screw blower type.

B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings. All designs must be approved by the Owner's Representative.

C. All equipment specified under this section shall be provided by a single manufacturer/supplier.

D. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume responsibility for the proper function of all equipment, following installation.

E. Blowers are to be installed in an indoor, non-conditioned space. The space shall be adequately ventilated to dissipate heat. The installation location is in Galveston, Texas, in close proximity to the Gulf of Mexico. Normal corrosion potential in a sub-tropical coastal environment is to be assumed. Provide equipment suitable for this location/environment.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300 – Submittals, and Section 01340 – Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Owner's Representative review.

C. Shop Drawings/Product Data. At a minimum, provide the following:

1. Make, model, weight, and horsepower of major items of equipment.
2. Complete equipment performance curve, including at least three specified performance points. The specified performance points shall correspond to the required points in the provided data sheets. At a minimum, flowrate, pressure, temperature, package power and efficiency shall be included at these specified performance points.
3. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
4. Any exceptions to the specifications.
5. Detailed structural, mechanical, and electrical drawings showing the equipment dimensions, size, and locations of connections, piping load limits, and weights of associated equipment.
6. Process and instrumentation diagrams showing all major components and all instruments in the blower package.
7. Wiring diagram showing the wiring of the entire package including all required connections and any optional connections.

8. If the manufacturer is supplying any loose accessory equipment, then outline drawings of the loose shipped accessories shall be provided.
9. Blowers are not foreseen to require any special foundations or anchoring and the need for a special mounting platform / slab is not foreseen. However, if the manufacturer does have any special requirement, these must be clearly stated with details of the static forces acting on foundation and static pad loadings etc.
10. Lifting equipment for minimum clearance lifts. Vendor is to review building drawings to confirm adequate headroom for placement and removal of blowers in their enclosures.
11. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications. See Sections 16222 and 16223 pertaining to AC Electric Motors for additional submittal requirements.
12. Factory finish system.

D. Quality Control Submittals. At a minimum, provide the following:

1. Certified CAGI/ISO 1217, Annex C (latest edition) test results, including all electronic data taken for each unit.
2. Location of U. S. factory authorized service centers, and parts inventory location for major components.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's printed installation instructions.
5. Manufacturer's Certificate of Proper Installation.
6. Millwright's certification of proper field alignment.
7. Suggested spare parts list to maintain the equipment in service for a period of 2 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
8. Provide special tools, with equipment for use prior to and during startup and for future maintenance per Specification 01700 Contract Closeout. Also provide spare parts suggested in the quantities suggested to have on hand.

E. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730 – Operation and Maintenance Data.

1.3 WARRANTY

A. Provide equipment warranty in accordance with the requirements of Section 01700 – Contract Closeout.

B. Parts availability shall be guaranteed from the manufacturer for 10 years after purchase. Should replacement parts not be available from the manufacturer, said manufacturer must replace all parts needed to bring the unit to a working condition or replace the entire blower package with a complete equal performance solution.

C. Extended Compression Element Warranty – 60 months from start-up or 66 months from shipping.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. See the data sheet for the blowers B-401, 402, attached.

2.2 ACCEPTABLE MANUFACTURERS

Provide equipment from one of the following acceptable manufacturers:

A. Screw Blowers:

1. Atlas Copco
2. Aerzen
3. Robuschi
4. Gardner Denver
5. Approved Substitution

2.3 QUALITY ASSURANCE

A. The Manufacturer shall have been in the business of manufacturing/design of blowers for a minimum of 5 years, and in the design of screw blowers for 5 years through direct experience, or through the purchase of design technology.

B. Certified Blower Test.

1. Each blower is tested hence each main drive motor has been tested for functional performance and shall not require a routine test on the motor only.

a. Each blower shall be tested in accordance with CAGI/ ISO 1217, Annex C (latest edition). Performance shall provide kW (HP) input to the package and a volumetric flow measurement at the maximum rated pressure and flow of the package according to published performance data. Measurement of flow is at the outlet of the package, net of all losses. Measurement of power will be at package input connections via the two-watt meter method. Package power consumption shall be considered during the test which will include the main drive motor power, Variable Speed Drive (VSD) losses, inlet filter & check valve pressure drop losses, oil cooler & oil pump.

b. Performance Tests shall be conducted using the job motor, job base frame and job controls system. Any exceptions required must be outlined in detail at the time of quotation. Measured package power must be within the allowable limit of ISO 1217.

c. Blower net delivered flow rate must be guaranteed with no negative tolerance other than those allowed in ISO 1217 and the discharge pressure shall be measured with no negative tolerance.

d. The capacity of the blower shall be defined as per paragraph 5.6 of the ISO 1217 Ed. 4 Test Code. The design discharge pressure shall be measured on the discharge side of the blower at the discharge flange.

e. The power computation shall be calculated as per paragraph 5.7 of the ISO 1217 Ed. 4 of the Test Code. Blower performance test shall be done by measuring delivered flow at the discharge flange of the blower unit, after check valve and discharge silencer.

2. A functional control check shall be performed on the control panel & all the on-skid instruments.

3. The measured blower performance shall be provided in a performance report and a statement of conformity will be supplied assuring all measurements were taken in accordance to ISO 1217 procedures and requirements.

4. Test results of the motors and blowers shall be supplied along with the Instruction / Operation & Spare parts manuals.

2.4 PRODUCT DESCRIPTION

A. Screw Blowers:

1. The blowers shall be variable speed, motor driven, single-stage, air cooled rotary screw type complete with integral gearbox and accessories as described. Rotary positive displacement lobe blowers are not acceptable.

2. Materials:

   1) Casing: Ductile iron.
   2) Seals: Labyrinth or carbon ring type.
   3) Base and Motor Pedestal: Structural and formed steel.
   4) Casing, Head plates, Gear Cover, End Cover: Ductile iron.

3. Casing: The blower casing shall be of one-piece construction, with separate head plates, and shall be made of close-grained ductile or cast iron suitably ribbed to prevent distortion under the specified operating conditions.
4. Rotors and Shafts: The rotors shall be of the screw involute type and shall operate without rubbing or liquid seals or lubrication. The impellers shall be statically and dynamically balanced by removing metal from the impeller body. Each impeller/shaft shall be supported by cylindrical roller bearings and fixed to control the axial location of the impeller/shaft in the unit. A double sealing arrangement shall be provided to prevent lubricant from contaminating the air stream.
5. Compensator: A stainless steel compensator shall be installed at the blower element discharge to ensure vibrations from the downstream piping are not transmitted to the blower compression element & vice versa.
6. Timing Gears: The impellers shall be timed by a pair of carburized and ground steel spur gears, mounted on the shafts with a tapered fit, and secured by a locknut or wedge rings.
7. Lubrication: There will be provided a positive oil seal at each bearing, designed to prevent lubricant from leaking into the air stream. The timing gears and the bearings shall be oil lubricated.
8. Drive System: The blower shall be mounted in a horizontal position as shown on the drawings. A suitable guard meeting OSHA specification shall be supplied.
9. Drive Motor: Provide TEFC motor, sized for horsepower as shown in data sheets, in accordance with Section 16222 – AC Electric Motors Less Than 100 HP, or Section 16223 – AC Electric Motors 100 HP and Above, as applicable. Motor rating will be 460-volt, 3 phase, 60 hertz.

B. OIL SYSTEM

1. The bearings and gears in the compressor element and gearbox shall be lubricated and cooled with oil which is at a temperature at ambient plus maximum 68 deg F.
2. The blower shall have a complete oil system generally comprised of the following:
   a. Oil sump
   b. Oil Breather
   c. Oil Pump, mechanically coupled to drive gearbox
   d. Air cooled oil cooler
   e. Oil filter
   f. Instrumentation (Pressure & Temperature)
3. Oil is circulated by pump from the oil reservoir through oil cooler, oil filter and oil manifold to the compressor element and gear box.
4. A by-pass valve shall open if the oil pressure rises above a set value.

C. BASE FRAME & ACOUSTIC ENCLOSURE

1. The blower shall be mounted on a sturdy industrial grade steel base frame with forklift slots allowing the unit to be placed on any level floor capable of taking the weight of the unit, no foundation or fixation should be required. The forklift slots shall be designed in the way that the blower can be manipulated by use of a manual pallet-jack or optional lifting device using a lifting beam allowing the use of an overhead crane.
2. The complete assembled blower / gearbox / motor unit should be mounted with vibration dampers in a 6-sided sheet metal acoustic enclosure which incorporates air inlet baffling to reduce the sound level under 80dB(A).
3. All service points to the blower should be easily accessible via the use of large door panels that should be easily mounted / dismounted.
4. The enclosure shall be strengthened with proper support structure to eliminate any damage during transport or during operation.
5. The electrical enclosure shall be UL listed according to UL 508A

6. Unit ventilation inlet grating and process air inlet grating shall be strictly separated. Both channels shall have a dedicated grating enabling a ducted channel for one, both or none of the flows, depending on the installation.
7. Unit ventilation outlet shall be at the roof top, enabling a ducted channel if preferred.
8. The dimensions for the enclosure shall not exceed 70 inches tall, by 60 inches wide, by 65 inches long.

2.5 CONTROL PANELS

A. Master Control Panel: A master control panel is required to allocate blower output. See Section 13413 – Control Panels and Section 13405 – Control System Operation. The master control panel shall receive D.O. and flow inputs via the basin sensor controllers. It shall then call upon the blowers to provide the required amount of air by providing output signals to be used for starting and stopping blowers, and controlling flow through speed control. The master control panel shall receive flow rates from the blowers and make corrections as needed to match the required flow rate demand and maintain discharge header pressure. The master control panel shall include an Ethernet switch, see Section 13417, Data Networking Equipment. Provide one local freestanding master control panel for the blowers.

B. Controls shall be mounted in a NEMA 12 stainless steel cabinet in accordance with Section 16160, Cabinets and Enclosures and Section 13400, Instrumentation and Control General Provisions.

C. The following instrumentation for control will be provided as a minimum for each blower:

1. Hand-off-auto (HOA) selector switch.
2. Local Start-Stop pushbuttons.
3. Blower outlet pressure transmitter.
4. Blower outlet temperature transmitter.
5. Oil pressure transmitter
6. Oil temperature transmitter
7. Shutdown relay connected to blower temperature, pressure.
8. Warning relay connected to blower temperature, pressure
9. Shutdown relay connected to oil temperature, pressure.
10. Warning relay connected to oil temperature, pressure
11. Alarm light for each item that can result in warnings or shutdown.
12. Dry contact for common alarm function for each blower for remote monitoring.
13. Elapsed run time meter for each motor. The elapsed run time meter shall be 6-digit, non-resettable, and sealed against dirt and moisture, 120 VAC, with indication of blower run time in hours with 1/10 hour increments.
14. Run-Off indicating lights.

D. Control points available for integration into future SCADA system through an ethernet connection shall include:

1. Dirty Inlet Filter Alarm (differential pressure across filter)
2. Outlet pressure gauge.
3. Outlet temperature gauge.
4. Run-Off indicating lights.
5. Blower Speed indicator.
6. Bearing oil temperature.
7. Bearing oil pressure.
8. Provide alarm point for each item that can result in shutdown.

E. Blower Start Up

1. Manufacture may choose the method for blower start up to be used as part of the supplied control methodology. The method may include the use of a blow off valve so that the blower starts in an unloaded condition, or the blower may start in a loaded condition utilizing the VFD to overcome the initial resistance.

2.6 ACCESSORIES

A. Each unit shall be furnished with the following accessory items:

1. Dry-type inlet filter with pressure differential transmitter, chamber type inlet and discharge silencers, flex connectors between blowers and silencers, OSHA certified belt guard (if belt driven), spring-type relief valves, discharge pressure transmitter, flanged check valve, butterfly valve and other related items to provide a complete blower system. Inlet filter to housing to be factory installed as part of blower package; not to be shipped loose.
2. Inlet air filter/silencer to be rated for 120 percent of design volume. Filter elements to be cleanable and replaceable. Filter and silencer to be adequately supported independently of blower.
3. Suitable flanged, reinforced flexible rubber isolation connection for both inlet and outlet or as required by the drawings.
4. Ammeter calibrated in both scfm and amps; supplied with a suitable current transformer.
5. PLC control shall generate flow rate based on test curve data, inlet and outlet pressure and temperatures.
6. Pressure transducers for intake calibrated for gauge pressure readings in the appropriate range.
7. Temperature transducers for intake and discharge calibrated for degrees Fahrenheit readings in the appropriate range.

2.7 COATING

A. Provide manufacturer's standard coating for equipment being placed in corrosive environments. Refer to sections 09928 – Protective Coatings for Wastewater Systems.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600 – Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Owner's Representative review.

B. Certification of all factory testing data and results shall be submitted for Owner and Owner's Representative review.

3.3 INSTALLATION

Install all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.4 INSPECTION AND TESTING

A. The Equipment Manufacturer shall furnish an experienced service representative to inspect the final installation of the equipment. The services of the representative shall be provided for a minimum of one (1), eight -

hour (8-hr.) day for each unit. If there are difficulties in operation of the equipment due to the manufacturer's fabrication, additional service shall be provided at no extra cost to the Owner.

B. Equipment shall be completely assembled, installed, painted, and approved by the manufacturer's factory representative. The equipment shall also be approved by the Owner's Representative.

C. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Owner's Representative.

3.5 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655 – Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661 – Instruction of Operation and Maintenance Personnel.

Aeration Blower Data Sheet

Project: Galveston Pirates Beach WWTP

Service Tag Number: B-401, 402	
Name: Aeration Blower 1, 2	
Manufacturer:	Atlas Copco
	Aerzen
	Kaeser
	Gardner Denver/Robuschi

Service Conditions

Fluid: Air

Design Point	Capacity %* SCFM	Outlet Flow (scfm)+	Discharge Pressure After Check Valve (psig)	Inlet Temp (ºF)	RH (%)	Package Power (kW) ++	Blower Discharge Temperature (ºF)
1	max = 100	*	10.2	110	95	*	*
2	*	760	10.2	110	95	*	*
3	*	600	10.2	110	95	*	*
4	*	230	10.2	110	95	*	*
5	min	*	10.2	110	95	*	*

+Flow rate, scfm at 14.7 psia pressure, 68 ºF temperature & 36 % RH.

++Package power means power consumed by the main drive motor plus all accessories including Variable Speed Drive (VSD) losses

Max discharge pressure required:	10.2 psig
Inlet Temperatures:	Max 110 deg F Min 45 deg F
Site elevation:	11 ft
Relative Humidity:	95%
Use following values for calculations:	MW 28.96 k 1.395 Cp 0.2497
Bower Location:	■ Indoor □ Heated □ Outdoor ■ Unheated
Electrical Code Classification: Unclassified	

Performance Data

Blower Type:	Rotary Screw Positive Displacement Blower
RPM at Max Air Demand: By manufacturer*	
Surge Pressure at Inlet conditions: By manufacturer*	
HP of Blower:	50 HP max single blower, 100 HP max total*
RPM of Blower at Max Air Demand Max Temp:	By manufacturer*
RPM of Blower at Design Demand Max Temp:	By manufacturer*
Surge Pressure at Max Air Demand Max Temp:	By manufacturer*
Surge Pressure at Design Demand Max Temp:	By manufacturer*
Cooling System Required? (Y/N):	Y* (for installation in sound enclosure)
Type of Motor:	TEFC*

Aeration Blower Data Sheet

Design and Materials	
Blower Housing:	By manufacturer*
Impellers:	By manufacturer*
Bearings:	By manufacturer*
Lubrication:	Oil
Blower Enclosure:	16 gauge* steel mounted on a I-beam skid

Drive Motor Specifications:
Manufacturer: To be integral with blower
Rated HP: 50 HP max single blower, 100 HP max total*
RPM (maximum sustainable): By manufacturer*
RPM (maximum peak): By manufacturer*
Frame: By manufacturer*
Phase/Hz/Volts: 3/60/460

Controls:
Variable Frequency Drive: To be coordinated by Contractor
PLC: Yes manufacturer standard
Instruments: All normally required by manufacturer as part of his blower package, but no less than inlet and outlet sensors for pressure and temperature, oil temperature and pressure, motor temperature sensors, power monitoring sensors, and sensors for any external cooling system that may be required.

Weights and Measurements:
Total Unit Weight (lbs.): By manufacturer* 3800 lb MAX

Other Details and Information: Provide inlet filters as required with the blower. Provide harmonic filters. Provide field instruments for a complete integrated package (9 thermal flow meters, 2 modulating butterfly valves, 6 luminescent DO probes, two ORP probes, two analytical transmitters for the 8 DO and ORP probes, two sun shields for the analytical transmitters.) Provide carrier for blower package to allow it to be hoisted by an overhead crane. Carrier must be able to pick up blower and operate in a clear zone of 7.5 ft (hook height off floor), combined weight of carrier and blower package to weigh no more than 2.5 tons. Provide pallet jack for moving and positioning blower packages for removal by overhead crane. Provide had truck for moving blowers to and from installed position to staging area for lifting by overhead crane.

* Vendor Confirmed or Supplied Information.

SECTION 11381

ODOR CONTROL SYSTEM

PART 1 - G E N E R A L

1. SECTION INCLUDES

   A. This section includes the requirements for the provision of one (1) odor control systems consisting of a Drum Scrubber, internal structural members, media with support grating, grease/mist eliminator, internal piping, electrical controls, valves, fan, and all necessary accessories.

   B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) to accommodate equipment with dimensions other than those shown on the drawings. All designs must be approved by the Owner's Representative.

   C. All equipment specified under this section shall be provided by a single manufacturer/supplier.

   D. Manufacturer/supplier shall be responsible for the manufacture, warranty, service, and operation of all equipment specified herein. Moreover, manufacturer/supplier shall, in addition to the Contractor, assume responsibility for the proper function of all equipment, following installation.

2. SUBMITTALS

   A. Contractor shall provide all submittals in accordance with the requirements of Section 01300, Submittals, and Section 01340, Shop Drawings, Product Data and Samples.

   B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Owner's Representative review.

   C. Shop Drawings/Product Data. At a minimum, provide the following:

      1. The odor control Manufacturer shall show evidence of at least five similar-sized design installations in satisfactory operation in wastewater treatment plant facilities for at least 3 years.
      2. If FRP vessel is proposed, the manufacturer shall submit detailed description of the laminate and the type of reinforcing to be used and a letter from the resin manufacturer stating:
         a. That the laminate and reinforcing material used will provide chemical resistance at least equal to the published chemical resistance for the resin for the intended application.
         b. That the resin will meet the performance requirements stated and is suitable for the service conditions specified herein and the fabrication technique proposed.
      3. If LDPE vessel in provided, the manufacturer shall proved a quality certificate in compliance of material used.
      4. Detailed shop drawings showing weights and dimensions of equipment, all nozzles and manways, wall thicknesses, laminate make-up, fabrication techniques, and construction materials.
      5. A description of the proposed quality control program that will be used during the manufacturing of the scrubber. Include the resume of the quality control manager.
      6. A schedule for the scrubber's fabrication along with the location of the fabrication site.
      7. Written instructions as to the recommended methods for unloading, storing, and installing the scrubbers and recommended lifting and handling procedures.
      8. Submit listing of previous installations and references to the Owner's Representative. The proposed vessel fabricator must demonstrate an experience record of at least 5 years with the manufacture of vessels for industrial service.
      9. Submit written installation procedures.

10. Submit certification indicating the quality control, testing, and inspection has been completed and standards specified herein have been met prior to shipment to the jobsite.
11. Schematic of the system, showing all components and controls.
12. Electrical data for all equipment.
13. Information and data for all instrumentation and controls and for the control panel, including wiring and interconnection diagram.
14. Control panel layout drawing and fabrication details.
15. Complete listing of physical and chemical process parameters required for proper operation of the system.
16. In addition, the following data for motors shall be provided:
    a. Motors:
    b. Name and manufacturer
    c. Type and model
    d. Bearing type and lubrication
    e. Horsepower rating and service factor
    f. Temperature rating
    g. Full load rotative speed
    h. Net weight
    i. Efficiency at rated load
    j. Full load current
    k. Overall dimensions
17. Submit certification indicating the quality control, testing, and inspection has been completed and standards specified herein have been met prior to shipment to the jobsite.
18. Schematic of the system, showing all components and controls.
19. Electrical data for all equipment.
20. Information and data for all instrumentation and controls and for the control panel, including wiring and interconnection diagram.
21. Control panel layout drawing and fabrication details.

D. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730, Operation and Maintenance Data.

3. WARRANTY

Provide equipment warranty in accordance with the requirements of Section 01700, Contract Closeout.

4. REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

B. American Society for Testing and Materials (ASTM)

C. Anti-Friction Bearing Manufacturers Association (AFBMA)

D. Hydraulic Institute

E. Institute of Electrical and Electronic Engineers (IEEE)

F. National Electric Code (NEC

G. National Electrical Manufacturers Association (NEMA)

H. Steel Structures Painting Council (SSPC)

PART 2 - P R O D U C T S

1. DESIGN CRITERIA

A. General: The Drum Scrubber shall be vertical, and shall consist of chemical resistance vessel, media, mist/grease eliminator, sump, and all internals. Each system shall follow the following performance requirements:

1. Headworks

a. Duty: Continuous air supply and odor source

b. Location: Outdoors

c. Inlet air temperature: 40-110 °F

d. Inlet relative humidity: 70-100%

e. Contaminants: H_2S, organic sulfur compounds, and other raw sewage odor constituents

f. Design airflow rate: 100 cfm

g. H_2S removal efficiency: ≥99% or ≤0.5ppmv in discharge, whichever is higher

B. Materials & Construction:

1. DRUM SCRUBBER

a. This specification defines the requirements for a Drum Scrubber-100 cfm, as manufactured by Purafil, Inc., PureAir Filtration, or approved equal.

b. The Drum Scrubber consists of dry-scrubbing media contained in a 55-gallon, linear, medium density, UV stabilized polyethylene or FRP drum with a blower mounted on top of a FRP lid.

c. The Drum Scrubber shall contain five stages of dry-scrubbing media with a total of 5 ft^3. Each stage shall measure 1 ft^3, weigh no more than 50 lbs, and be contained in a media package.

d. The Drum Scrubber shall be designed to operate at 99.5+% gas removal efficiencies.

e. The airflow capacity shall be 100 cfm at 6 iwg including 2 iwg of external static pressure. The unit includes an outlet damper which can be used to vary the airflow.

f. The configuration shall be arranged so that the contaminated air shall flow into the bottom inlet plenum and be drawn upwards through the media bed. Treated air shall discharge out the top of the vessel through a centrifugal air ventilator.

g. All components of the Drum Scrubber shall include:

1. 55-gallon, medium density, UV stabilized polyethylene drum and FRP lid
2. 5 ft^3 of dry scrubbing media or as determined by manufacturer
3. Centrifugal Aluminum blower with slide gate damper
4. Fernco 4” Inlet
5. Silencer on outlet
6. Rain hood
7. Mist/Grease Eliminator with 2 Fernco Fittings
8. NEMA 4x Control Panel with Motor Starter
9. Skid Mounted

2. DRUM

   a. The drum material shall be linear, medium density, UV stabilized polyethylene, 3/16" in thickness.

   b. The drum shall have a minimum capacity of 55 gallons and measure 22" in diameter and 36" in height.

   c. Latches shall be stainless steel and rubber.

   d. Fasteners shall be stainless steel.

   e. The drum shall contain enough media to meet design requirements.

   f. The media shall be supported by a system of thermoplastic packing to provide maximum diffusion.

   g. The inlet shall have a 4" FERNCO flexible coupling, or equal.

   h. The drum shall have a 0.75" diameter drainpipe.

   i. A polymedia filter shall be used to separate the packing from the different media.

3. BLOWER SECTION

   a. The blower be sized to deliver 100 cfm at 6 inches of water column.

   b. The blower shall consist of a direct drive motor-fan assembly.

   c. The motor shall be a 1/2 hp, 3450 RPM, 115 volt / 1 phase/ 60 Hz TEFC motor.

   d. The motor shall be pre-wired with a 6 ft UL approved grounded power cord.

4. CHEMICAL MEDIA

   a. Provide manufacturer media necessary to meet design requirements.

   b. Media must be Non-Hazardous before and after it is spent.

   c. Only UL certified media will be accepted in this MDPE vessel with companies that contain additional product liability on their systems.

   d. All media must have proof that is made and produced in the United States for additional verification of product performance.

   e. The general contractor is responsible for all design cost changes, engineer review time, and testing verification for media not listed and previously approved.

5. MIST/GREASE ELIMINATOR/PRE-FILTER

   a. The mist eliminator shall be designed to remove 99% of water vapor (>4 micron diameter)

   b. The mist eliminator shall be located at the air inlet and include a Trap Guard drain.

   c. The mist eliminator pad shall be 2 inches in thickness at a minimum and shall consist of six layers of Kimre 16/96 general purpose polypropylene mesh, or equal.

   d. In line mist eliminator will be provided in a low-density polyethylene housing, or equal.

   e. Pressure taps and gages shall be installed and include a magnehelic type as manufactured by Dwyer (Series 2000), or approved equal, to indicate when filter requires cleaning.

f. Fernco fittings shall be provided on both sides of transitions, 4" diameter, or equal.

6. CONTROL PANEL/MOTOR STARTER

a. NEMA 4X, 316 stainless steel enclosure

b. Motor starter: FVNR, ATL, with overload heaters, a NEMA style starter sized accurately for 1/2 h.p. 115/1/60 hz VAC motor.

c. Main circuit breaker, magnetic, with front-panel operating handle.

d. Fan fail contact for future SCADA.

e. Operator interface and display:

1. "Hand-Off-Auto" selector switch

2. Indicating lamps (all lamps are push-to-test style):

i. "Fan Off"

ii. "Fan Running"

iii. "Fan Fail"

PART 3 - E X E C U T I O N

1. DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600, Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

2. FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Owner's Representative review.

B. Certification of all factory testing data and results shall be submitted for Owner and Owner's Representative review.

3. INSTALLATION

A. Install all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

B. Provide the required nutrient solution for initial operation.

C. Set anchor bolts in accordance with the manufacturer's recommendations. Use antiseize compound on all stainless steel bolts.

4. INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by the both the manufacturer's factory representative and the Owner's Representative.

B. <u>GENERAL</u>:

1. The Contractor shall be responsible for all costs associated with odor control system testing.

C. <u>Functional Testing</u>:

1. Using non-odorous ambient air, the entire odor control system shall be operated for not less than 24 continuous hours in order to demonstrate the mechanical and electrical integrity of the system. Any mechanical or electrical breakdowns, unusual vibrations, or control sequencing problems shall be considered sufficient cause to reject the test. Inability to successfully complete the functional testing in five tries shall be considered cause for the construction manager to reject the odor control system. Contractor shall balance all air flows prior to system performance testing.

D. PERFORMANCE TESTING:

1. The performance tests shall be conducted after sufficient acclimation time and at such time as all anticipated odorous air streams are present in the scrubber inlet. The time of the tests and detailed test procedure shall be submitted for approval prior to the testing period.

2. During testing, scrubber air flow rates shall be held constant. Changes in scrubber system operating conditions shall not be permitted. All fine-tuning of operating conditions shall be performed prior to testing.

3. Design operating conditions shall be maintained for a minimum of 4 hours. During this time, all pertinent operating parameters shall be monitored and recorded and sufficient sampling and analysis shall be conducted to demonstrate that flow rates are at design conditions.

4. Hydrogen sulfide concentration shall be measured in each scrubber inlet and outlet. Inlet and outlet levels shall be measured once every 30 minutes using a portable H2S analyzer such as Interscan, Jerome or equal.

5. Results: A description of the performance tests shall be submitted. The hydrogen sulfide compound removal efficiency shall be as specified in the design and performance requirements. Should scrubber system performance not meet any of the above requirements, that system shall have failed the performance test. The Manufacturer shall make any additions or modifications to that scrubber system as may be necessary, at no additional cost to the Owner, and the performance tests for that system shall be repeated in its entirety.

6. Demonstrate with a Final Acceptance Test that these Specifications have been met by the equipment as installed. As a minimum, perform the following tests.

a. That rotating equipment has been properly installed and is in correct alignment.

b. That units operate without overheating or overloading any parts and without objectionable vibration.

c. That there are no mechanical defects in any of the parts.

d. That the controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper high-level alarm functions.

E. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer’s factory representative. Manufacturer’s factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Owner’s Representative.

5. START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655, Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

C. The system manufacturer's representative shall be present at the job site for the following time period for Start Up; travel time excluded:

1. One day for inspection and certification of the installation.
2. One-half day to train Owner's staff in operation of the system.

END OF SECTION

SECTION 13100

LIGHTNING PROTECTION SYSTEM

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

Provide labor, materials, design, engineering, installation drawings, appurtenances and inspections required for a comprehensive lightning protection system. The required lightning protection system shall include the following structures and buildings.

A. Headworks Structure

B. MCC/Blower Building/Aeration Basin Structure

C. UV/Filter Structure

D. NPW Structure

E. Generator Structure

1.2 REFERENCE STANDARDS

Comply with the latest edition of the following standards.

A. ANSI/NFPA No. 780 - Standard for the Installation of Lightning Protection Systems.

B. UL 96A - Master Labeled Lightning Protection System, Installation Requirements.

C. LPI 175 - Lightning Protection Institute Installation Standard.

1.3 SUBMITTALS

A. Shop Drawings. Detailed plan drawings shall be prepared at scale to indicate all work to be performed. Details of all component mounting, and connections shall be included on separate detail drawings. Manufacturer's catalog numbers and generic identification shall be indicated for all components shown on the drawings. Secure formal approval of shop drawings and product data prior to ordering material. Secure approvals in sufficient time to allow installation of concealed system components without delaying the project.

B. Product Data. Submit complete descriptive information on all materials and installation methods.

C. Certifications. Evidence of compliance with Article 1.4.

1.4 QUALITY ASSURANCE

A. Provide system design equal to or exceeding the requirements of UL 96A for a Master "C" Label. Upon completion, make application to the Underwriters Laboratories, Inc. for inspection and certification and deliver to the Owner certification ensuring that the installed system meets UL 96A. If the system does not pass the certification inspection, make corrections to the system to pass the certification inspection at no additional cost to the Owner.

B. Employ personnel recognized as being regularly engaged in the design and installation of lightning protection systems, listed by Underwriters' Laboratories, Inc., and fully qualified in the field of lightning protection.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. ERICO International Corporation.

B. Robbins Lightning, Inc.

C. Thompson Lightning Protection, Inc.

D. Other manufacturers who can comply with paragraph 1.4.

2.2 GENERAL

A. The system furnished under this Section shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest approved design. Listing of the manufacturer in the lightning protection section of the current edition of Underwriters' Laboratories, Inc., Electrical Construction Materials List will be accepted as compliance with this requirement. Materials used in connection with the installation of the lightning protection system shall be approved for lightning protection systems by the Underwriters' Laboratories, Inc. No combination of materials shall be used that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture. Where unusual conditions exist, which would cause deterioration or corrosion of conductors, conductors with suitable protective coatings or oversize conductors shall be used. If a mechanical hazard is involved, the conductor size shall be increased to compensate therefore, or suitable protection shall be provided. The conductors may be protected by covering them with molding or tubing, preferably made of nonmagnetic material.

B. Where new systems are extended from existing systems, use established material types and terminations. Otherwise, use materials as specified herein.

2.3 CONDUCTORS

Conductors shall be tinned-copper or aluminum of the grade ordinarily required for commercial electrical work. Conductor minimum sizes are listed in Tables 3-4 and 3-5 of NFPA 780.

2.4 AIR TERMINALS

Air terminals shall be nickel-plated solid copper or aluminum alloy with tapered bullet point tips (in lieu of sharp point tips). Minimum air terminal size shall be 5/8-inch diameter by 24 inches long. Where air terminals longer than 24 inches are required, solid copper rods of the appropriate length with threaded ends may be securely attached to the air terminals for extensions. Provide a three-leg tripod brace for each air terminal at an open roof location. Secure the triangular brace to the roof in a manner approved by the roof vendor. All other air terminals shall have a bipod brace. Conductor connections to air terminals shall be bolted.

2.5 GROUND RODS

Ground rods shall be copper-clad steel, 3/4-inch diameter by 10 feet in length.

2.6 CONNECTIONS

All underground and concealed connections shall be made with exothermic welded connections. Visible connections shall be made with cast bronze bolted pressure connectors which utilize stainless steel or silicon bronze bolts. Provide 4-inch parallel clamp connectors for conductors, bonding plates, and cross-run clamp or similar heavy-duty clamps.

2.7 ROOF PENETRATIONS

Accomplish roof penetrations with through-roof fittings specially designed for this purpose, which utilize solid rods with appropriate hardware. Fittings shall incorporate a positive means for sealing around the rod.

PART 3 - E X E C U T I O N

3.1 GENERAL

Design and install a complete lightning protection system consisting of air terminals, conductors, connectors, attachments, grounding and necessary appurtenances to comply with minimum requirements listed in the referenced standards. The system shall be installed in a neat workmanlike manner and without interfering with other building systems.

3.2 CONDUCTORS

Provide downlead conductors concealed in PVC conduit embedded in the concrete columns or inside wall. Secure conductors to the roof or other structure at a maximum interval of 3 feet.

3.3 AIR TERMINALS

Air terminal installations shall be designed and braced for 100 mph winds with 125 mph gusts.

3.4 METTALLIC ROOF MOUNTED EQUIPMENT

Bond metallic roof mounted equipment including but not limited to HVAC equipment, antennae, vents, flues and light fixtures in accordance with ANSI/NFPA 780.

3.5 GROUND RODS

Provide counterpoise ground loops as indicated on the Drawings consisting of #4/0 AWG bare stranded tinned-copper installed a minimum of three feet below grade and three feet from foundations. Connect ground rods, ground test wells and downlead conductors to the counterpoise loops as shown on the Drawings.

3.6 CONNECTIONS

Provide exothermic connections for all below grade connections and splices. Provide exothermic connections for all above grade cable spices. Provide bolted-pressure connections to air terminals and above grade piping.

3.7 ROOF ATTACHMENTS AND PENETRATIONS

Air terminals, conductors and appurtenances for the lighting protection system require attachment to building roofs. Downleads may require penetration of roof surfaces. All attachments to or penetrations through roofs shall be in strict accordance with the roof manufacturer's recommendations. The lightning protection subcontractor shall submit details of all roof attachments and penetrations to the appropriate roof manufacturer for approval prior to

installation. Once the lightning protection system installation is complete, engage the appropriate roof manufacturer to inspect all roof attachments and penetrations on that manufacturer's roof. Subsequent to the inspection, the roof manufacturer shall furnish the Owner with a letter indicating that all lightning protection system component roof attachments and penetrations are satisfactory and that such attachments and penetrations will not in any way reduce the manufacturer's warranty on the roof. Pay any fees for services or inspections provided by the roof manufacturer to accomplish the above related requirements.

3.8 COVER-UP INSPECTION

Prior to cover-up of concealed components and connections, notify the Owner so that a cover-up inspection can be performed. Correct any deficiencies prior to concealment of components and connections.

3.9 CONFLICTS

In the event a conflict exists between this specification and any of the referenced standards, the reference standard shall govern.

END OF SECTION

SECTION 13122

PRE-CAST CONCRETE BUILDING

PART 1 - G E N E R A L

1.1 SUMMARY

A. Basis of Design: Contractor to furnish pre-cast, post-tensioned concrete building. Building to be field erected on level, contractor furnished, poured-in-place floor slab in accordance with design drawings (by others). Pre-cast building to be EASY-SPAN as manufactured by Lonestar Prestress Mfg., Inc., Houston, Texas or approved equal. Building to be provided by manufacturer with all necessary openings as specified in conformance with manufacturer's structural requirements.

1.2 CODES, STANDARDS AND REFERENCES

A. ACI-318-11, “Building Code Requirements for Structural Concrete”.

B. ASCE-7-10, “ Minimum Design Loads for Buildings and Other Structures”.

C. 2012 IBC, “2012 International Building Code”.

D. PCI Design Handbook, Precast/Prestressed Concrete Institute. 6th Edition.

E. “Manual of Standard Practice”, Concrete Reinforcing Institute.

F. ASTM, American Society for Testing and Materials:

1. C150 - Standard Spec. for Type I and Type II – Low Alkali Portland Cement.
2. C33 - Standard Spec. for Concrete Aggregates.
3. A36 - Standard Spec. for Carbon Structural Steel.
4. A615 - Standard Spec. for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. A706 - Standard Spec. for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
6. A416 - Standard Spec. for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
7. A185 - Standard Spec. for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
8. A307 - Standard Spec. for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
9. A123 - Standard Spec. for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
10. A153 - Standard Spec. for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.3 QUALITY ASSURANCE

A. Building fabricator must have a minimum of 10 years of experience manufacturing pre-cast concrete buildings.

B. Fabricator must be a producer member of the National Precast Concrete Association (NPCA).

C. No alternate building designs will be allowed unless pre- approved by the owner TEN (10) days prior to the bid date.

1.4 DESIGN REQUIREMENTS

A. MCC/Blower Building Wall Panel Dimensions:

Exterior: 20’-0” x 38’-0” x 12’-0 1/2” (eave height).
Interior: 18’-11” x 36’-11” x 12’-0” (clear interior height).

B. Standard Design Loads:

1. Standard Wind Loading - 160 MPH (ASCE 7-10, Category III, Exposure C, Enclosed Building)

2. Standard Roof Live Load - 20 PSF.

3. Standard Snow Load – Determine per ASCE 7-05 (including Snow Drift) for 0 PSF Ground Snow Load & 5 PSF Rain-on-Snow Surcharge, Importance Factor I = 1.1

4. Standard Floor Live Load - 250 PSF (where Applicable)

5. Seismic Design category ‘A’, Seismic Importance Factor, I=1.25.

C. Roof: Roof panel shall slope 1/2” in direction as indicated in drawings from peak to edge. The roof shall extend a minimum of 4" beyond the wall panel on each side and have a turndown design which extends 3/4" below the top edge of the wall panels to prevent water migration into the building along top of wall panels. Roof shall also have an integral architectural ribbed edge.

D. Keyway Roof Joints: Grout in keyway shall be polymer concrete placed after coating keyway with a methyl methacrylate resin and isocyanate resin.

E. Foundation (poured-in-place floor slab by contractor): There shall be a 1-1/2” deep by 10” recess cast into the perimeter of floor slab except at doorways. The 1-1/2” recess makes the interior floor surface 1-1/2” higher than the joint between the wall panel and floor slab preventing intrusion of water. Building manufacturer will provide wall anchors at time of erection of panels.

F. Walls to be of an insulated precast concrete sandwich panel type. The walls shall have an extruded polystyrene core sandwiched between interior and exterior concrete wythes. The wall panels shall have a minimum thickness of 6 1/2”. Minimum wythe thickness shall be 2”. The walls shall have a minimum required thermal performance (R-value) of R-10 as required by 2015 IECC.

1.5 SUBMITTALS

A. Design calculations prepared and sealed by a professional engineer, licensed in the state of Texas, shall be submitted.

PART 2 – P R O D U C T S

2.1 MATERIALS

A. Concrete: Steel-reinforced, 6000 PSI minimum 28-day compressive strength.

B. Reinforcing Steel: ASTM A615, grade 60 or ASTM A185, grade 80 unless otherwise indicated.

C. Post-tensioning Strand: Roof shall be post-tensioned in field after keyway is filled and has cured to required strength (psi). Post-tensioned cable shall be 41K Polystrand CP5O, .50 in., 270 KSI, 7-wire ungreased strand (ASTM A416). There will be a minimum of five post-tensioning cables connecting roof and floors together to provide watertight joint.

D. Sealant: All joints between panels shall be sealed on the exterior and interior surface of the joints. Sealant shall be SIKAFLEX-IA elastic sealant or equal. Exterior sealant joint to be 3/8" x 3/8" square so that sides of joint are parallel for correct sealant adhesion. Back of joint to be taped with bond breaking tape to ensure adhesion of sealant to parallel sides of joint and not the back.

E. Panel Connections: All panels shall be securely fastened together with 3/8” thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A36 and hot dipped galvanized after fabrication. All fasteners to be 1/2" diameter bolts complying with ASTM A307 for low-carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior #F-63, or equal. All inserts for corner connections must be secured directly to form before casting panels. Floating of connection inserts will not be allowed.

2.2 ACCESSORIES

A. Door and Frame: Refer to section 08110 Hollow Metal doors and frames and section 08410 Aluminum Framed Storefronts.

B. Door Hardware: Refer to section 08710 Door Hardware.

C. Gutters: Refer to section 07710 Roof Specialties.

D. Downspouts: Refer to section 07710 Roof Specialties.

E. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.028-inch thickness.

2. Concrete type, embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.

F. Corners: Factory mitered and continuously welded or mechanically clinched and sealed watertight.

1. Color: as selected by Architect from manufacturer's full range.

G. Elastomeric sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

H. Butyl sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

I. Roof Edge Specialties: Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements. Refer to Section 07710 Roof Specialties.

J. Roof System: Refer to section 07545 Thermoplastic Polyolefin Roofing (TPO) Roofing.

K. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

L. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

M. General Roof Performance: Installed roofing and metal edge shall withstand specified uplift pressures as required by enforced building code, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and metal edge shall remain watertight.

2.3 FINISHES

A. Interior of Building: Smooth steel form finish on all interior panel surfaces. Some form marks and seams may be visible. Marks or seams that protrude more than 1/8” shall be ground down and sacked. Paint ceiling surfaces with white epoxy paint. Paint wall and floor surfaces with ultra-low VOC (26g/L) water-based epoxy with a durable, high resistant finish; PPG AQUAPON WB EP or equal.

B. Exterior of Building: Architectural precast concrete Smooth Trowel finish coated with the following acrylic concrete stain:

1. Cementrate by FOSROC or Canyon Tone stain by United Coatings. Stain color shall match be selected from manufacturer’s standard colors. Stain shall be applied per manufacturer's recommendation. Joints shall be kept substantially free of stain and to match color of the other buildings as noted on drawings.

PART 3 - E X E C U T I O N

3.1 DELIVERY, STORAGE & HANDLING

A. The building shall be stored on dunnage placed at the proper locations to prevent cracking, distortion, or any other physical damage.

B. The building shall be shipped F.O.B. jobsite by the Manufacturer. It shall be provided with Burke lifting fixtures for lifting and setting the building without incurring damage to the walls or roof.

C. The Building Manufacturer shall provide all cables and lifting hardware for use in off-loading and setting the building.

3.2 WARRANTY

A. The Manufacturer shall warrant the building and its components for one year from the date of installation.

B. The precast concrete structure shall endure and not deteriorate for a period of twenty-five (25) years.

END OF SECTION

SECTION 13400

INSTRUMENTATION AND CONTROL GENERAL PROVISIONS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of general instrumentation and control requirements for the City of Galveston Pirates Beach Wastewater Treatment Plant.

B. The requirements outlined in this section address general hardware, software, and system services necessary to provide the specified control functions. More detailed requirements of specific functions and components are presented in other sections that follow.

1.2 DEFINITIONS

A. Where the word “provide” appears in these specifications, it shall be construed to mean “furnish and install complete and ready for safe and regular use.”

B. The definitions of terminology used in the specifications shall be as defined in ISA Standard 51.1 unless otherwise specified. Where terms used are not defined in ISA 51.1 or in these specifications, IEEE Standards Dictionary: Glossary of Terms & Definitions, ISA S50.00.1 or other ISA standards shall apply.

1. Signal Circuit. Any analog circuit whose principal purpose is the conveyance of information and not the conveyance of energy for the operation of an electrically powered device.
2. Control Circuit. Any digital circuit whose principal purpose is the conveyance of information and not the conveyance of energy for the operation of an electrically powered device.
3. Power Circuit. Any circuit whose principal purpose is the conveyance of energy for the operation of an electrically powered device.
4. Two-Wire Transmitter. A transmitter which derives its operating power supply from the signal transmission circuit and, therefore, requires no separate power supply connections. As used in this specification, two-wire transmitter refers to a transmitter which provides a 4 to 20 milliampere current regulation of signal in a series circuit with an external 24-volt direct current driving potential and a maximum external circuit resistance of 600 ohms.
5. Electrical Isolation. Pertaining to an electrical node having no direct current path to another electrical node. As used in this specification, electrical isolation refers to a device with electrical inputs and/or outputs which are galvanically isolated from ground, the device case, the process fluid, and any separate power supply terminals; but such inputs and/or outputs are capable of being externally grounded without affecting the characteristics of the device or providing a path for circulation of ground currents. The terms “galvanic isolation,” “electrical isolation,” “isolation,” or similar terms shall mean electrical isolation whenever used in the specifications for electrical control and instrumentation equipment. Unless otherwise specified, electrical isolation for analog signal devices shall be in accordance with ANSI/IEEE C39.5.
6. Panel. An instrument support system which may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term “panel” in these contract documents shall be interpreted as a general term which includes flat panels, enclosures, cabinets and consoles.
7. Data Sheets. Data sheets, as used in this specification, shall comply with the requirements of ISA 20.
8. Field. Locations external to a panel or piece of equipment where a field device is connected.
9. Control Room. An environmentally controlled area intended for housing control equipment, computers, control panels, etc., and intended for those parts of a control system for which operator surveillance is required on a continuing basis.
10. UPS. Uninterruptible Power Supply.

11. HMI. Human-Machine-Interface. The control system hardware and software associated with providing the visual interface between system users and the control system.
12. PLC. Programmable Logic Controller. Field installed unit which monitors and controls devices, located within the plant. The PLCs contain all logic necessary to monitor and control the system process located at the PLC location.
13. SCADA. Supervisory Control and Data Acquisition.
14. RTU. Remote Terminal Unit. Similar to a PLC, except in a more compact form.
15. DCS. Distributed Control System.
16. Auto Dialer. Remote Monitoring System with Cellular Communications.

1.3 REFERENCE STANDARDS

This subsection references the latest revisions of the following standards. They are a part of Division 13 as specified and modified. In case of conflict between the requirements of this section and those of the listed standards, the requirements of this section shall prevail.

Standard	Title
ANSI/NEMA ICS 6	Enclosures for Industrial Control and Systems
ISA 5.4	Instrument Loop Diagrams
ISA 20	Specification Forms for Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA 50.00.1	Compatibility of Analog Signals for Electronic Industrial Process Instruments
ISA 51.1	Process Instrumentation Terminology

1.4 WARRANTIES, MAINTENANCE, AND SUPPORT SERVICES

A. Warranty. The manufacturer shall provide an all-inclusive 2-year warranty. The submittal shall provide a contract specific warranty document as detailed in the specifications.

B. Software Maintenance. After system software or equipment has been placed in service and tested, the Owner may request reasonable additions, modifications and deletions, at no additional cost to the Owner, to control strategies, displays, database, and reports.

1.5 CONTRACTOR'S QUALIFICATIONS

A. Perform all work necessary to select, furnish, configure, customize, debug, install, connect, calibrate, and place into operation all hardware and software specified within this section and in other sections.

B. Aeration Controls: If the blower manufacture supplies a control system capable of providing master control where outside inputs are monitored and responded to by sending operation instructions to subservient blower VFD controllers they shall be utilized. In this case, in order to provide single source vendor responsibility, the blower manufacturer shall also provide the valves, flow meters, and D.O. instruments and any other devices deemed necessary so that control can be achieved with the supplied system. If the blower vendor does not supply such a control system, the blower vendor may package their blower system and controls and use the services of a systems integrator to provide a PLC based master control system. Similarly, they shall also provide valves, flow meters and D.O. systems necessary so that control can be achieved with the supplied system.

C. Utilize the following "systems integrator," who is regularly engaged in the design and the installation of instrumentation and control systems and their associated subsystems as they are applied to the municipal water or wastewater industry:

CPUSA
9207 Marbach Road
Suite 106
San Antonio, TX 78245
Cell: (210) 420-7732
Email: jtriggs@controlpanelsusa.com
Webpage: www.controlpanelsusa.com

Prime Controls
10400 Westoffice, Suite 105
Houston, TX 77042
www.prime-controls.com
Attn: Jason Ford, Project Manager
Toll Free 866-99-SCADA
Office: (713) 244-9747
Email: j.ford@prime-controls.com
Web Page: www.prime-controls.com

For the purposes of this specification section, "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs a registered professional Control Systems Engineer or registered professional Electrical Engineer to supervise or perform the work required by this specification section.
2. Employs personnel on this project who have successfully completed a manufacturer's training course on the configuration and implementation of the specific programmable controllers, computers and software proposed for this project.
3. Has performed work of similar or greater complexity on at least three projects within the last 5 years and has implemented and completed at least one of these three projects with the proposed HMI software.
4. Has been in similar industries performing the type of work specified in this specification section for at least 5 continuous years.

D. Maintain a fully equipped office/production facility with full-time employees capable of fabricating, configuring, programming, installing, calibrating, troubleshooting, and testing the system specified herein. Qualified repair personnel shall be available and capable of reaching the facility within 24 hours.

1.6 SUBMITTALS

A. General.

1. Submit to the Owner technical data and drawings for all equipment, materials, software, assemblies, and installations prior to fabrication and installation. In all instances in which submittals are required by the specifications, do not proceed with the associated work until the submittal has been Successfully Reviewed.
2. Each submittal shall be complete, with all required information provided together at one time, and submitted in a sequence that allows the Owner to have all of the information necessary for checking and approving a particular document at the time of the submittal. Plan and make all submittals as necessary to avoid delays or conflicts in the work.

B. Submittal Categories.

1. Project submittals are divided into the following general categories:
   a. Design Submittals.
   b. System Documentation Submittals.
   c. Testing Submittals.
   d. Training Submittals.
2. The following paragraphs define the specific contents of each of these submittal categories. The requirements outlined for each of these submittals shall apply to all equipment and services specified in the appropriate section of the specifications. Additional submittal requirements may be found in other sections of the specifications.

C. Design Submittals.

1. Hardware Submittal.
   a. Product information shall include, but not be limited to: catalog cuts, data sheets, performance surveys, test reports, equipment lists, material list, diagrams, pictures, and descriptive material. The product information shall cover all items including mechanical devices, mounting components, wiring, terminal strips, connectors, accessories, and spare parts. The submittal information shall show product features, as well as all performance data and specifications.
   b. Prior to commencement of manufacture (or shipment for stock items), submit for review product information for all equipment and material specified in the specifications, or required to support equipment, or systems specified in the specifications. Specific requirements for the form and content of product information submittals are included in the individual section that defines the equipment requirements.
2. Connection Diagrams. Submit the following:
   a. Connection diagrams shall show the placement, labeling and wiring of components within panels, cabinets and consoles. Components shall be shown arranged in the physical layout (not necessarily to scale) as it would appear to a person servicing the equipment. Connection diagrams shall include all internal wiring of the panel and connections to external devices. This shall include AC and DC power wiring and multi-conductor cables from PLC I/O modules to the associated termination blocks. Wires shall be shown as a continuous line between their termination points. Each wire label designation shall be shown. The wire label designations on each end of a single wire must be identical. All wire termination point numbers shall be shown. Signal and DC circuit polarities shall be shown. All jumpers, shielding and grounding details shall be shown.
   b. Submit connection diagrams for all new panels, cabinets and consoles.
   c. Furnish drawings on paper, electronically as Adobe PDF files, and in the latest AutoCAD electronic format. Electronic files shall be submitted in CD or DVD format.
3. Panel Fabrication and Layout drawings. Submit the following:
   a. Panel fabrication drawings shall be drawn to scale and show the physical dimensions, materials, and construction of panels, cabinets, terminal boards, consoles, or other electrical or mechanical equipment enclosures. These drawings shall show the physical arrangement and mounting of all components in or on a panel, terminal board, cabinet, console, or enclosure, as well as the physical dimensions, and the space and mounting requirements of mechanical, electrical, control and instrumentation devices or pieces of equipment. Include ventilation requirements, locations of connections, weight, paint color, material and dry film thickness that are applicable to this design.
   b. Panel fabrication and layout drawings shall include a bill of materials; front, back, and section views; the locations of all components to be mounted in or on the panel, cabinet, console, enclosure or assembly; drawing scale; nameplate engraving schedule; and structural materials and supports. Overall dimensions and minimum clearances shall be shown. Sufficient detail shall be included to demonstrate material choices, outward appearance, construction methods, and seismic force resistance.
   c. Complete shop drawings shall be prepared and submitted for all panels, cabinets, and consoles which are custom fabricated or modified for this project. The Owner shall have the right to make modifications to the interior and exterior layouts of panels as part of the shop drawing review.

d. Furnish drawings on paper, electronically as Adobe PDF files, and in the latest AutoCAD electronic format. Electronic files shall be submitted in CD or DVD format.

4. Interface Cables. Submit interface cable pin-out/cable makeup diagrams. This includes all network cables, radio to PLC/RTU cables, computer to PLC cables and printer cables. Submittal shall include copies of the actual hardware documentation. All cables shall either be standard cables from the manufacturer or custom-made. Custom cables must not require the use of gender changers, 9-25 pin converters, null modem adapters, etc., for them to function correctly.

5. Interconnection Diagrams. Submit cable interconnection diagrams. These interconnection diagrams shall include typical wiring diagrams for each type of product. Wires shall be shown as a continuous line between their termination points. Each wire label designation shall be shown. The wire label designations on each end of a single wire must be identical. All wire termination point numbers shall be shown. Each wire color shall be shown. Signal and DC circuit polarities shall be shown. All jumpers, shielding and grounding details shall be shown.

6. Installation drawings. Submit panel installation drawings. These panel installation drawings shall show installation arrangements for all provided equipment, mounting and anchoring details, conduit entries into cabinets, and control system electrical power supply distribution conduit and wiring. Data sheets and/or catalog cuts for mounting devices, anchors, wire and other incidental installation materials shall be included.

7. Software. Submit the following software documentation for review:

a. OEM Software. Submit the product data sheets for OEM software supplied under this contract. OEM software packages include HMI software, RTU/PLC configuration/programming software, reporting software (if not part of the HMI software), and other third-party software provided under this contract.

b. Application Software. Application software includes the software and programming developed to implement the specific requirements of the drawings and specifications.

1) Submit functional design descriptions of the application software that implements the control strategies described in the drawings and specifications. These descriptions shall include field actions/interactions, control interlocks, sequencing, alarms to be generated, and operator interactions with the control strategy.

2) Submit fully annotated program listings for PLC/RTU programming showing but not limited to the following:

a) Custom programming provided.
b) Communication Port configuration.
c) I/O module configuration.
d) System architecture.
e) Field bus layout and configuration.
f) Database layout and tag naming.

3) Submit color screen prints of custom graphic screens for the HMI and layout drawings for any field panel interfaces. This submittal shall also include a list of the symbols and color scheme for the presentation of the various data.

D. Operation and Maintenance (O&M) Manuals.

1. Supply O&M manuals for all the equipment and software provided. O&M manuals shall be developed for personnel at the level of electronic technician. O&M manuals shall describe the detailed preventive and restorative procedures required to keep the equipment in good operating condition. An O&M manual or a set of manuals shall be furnished for all deliverable hardware, including OEM equipment. O&M manuals for OEM equipment shall contain original printed materials, not copies, and may be provided in the manufacturer's original format. Manuals shall be provided in electronic format.

2. Instruction Manual.

a. The manual shall be written in English and illustrated in detail to the component level, including assemblies, subassemblies, and components. It shall contain a detailed analysis of each major component so that maintenance personnel can effectively service, inspect, maintain, adjust, troubleshoot, and repair the equipment.

b. Each manual shall include a Table of Contents, arranged in systematic order, and shall be divided into the following sections:

1) Introduction. The purpose of the manual, special tools and equipment, and safety precautions.

2) General Information and specifications. A general description of the equipment item and specifications of its major components.

3) Listings. Supplier's name, address, and telephone number. Each product shall include name, address, and telephone number of subcontractor, or installer, recommended maintenance contractor, and local source for replacement parts.

4) Theory of Operation. The relationship of assemblies, subassemblies, components and interchangeability of components, and explanation and analysis of their functions to the smallest board replaceable components.

5) Software. Listing and explanatory text for any software or firmware.

6) Operation Procedures. The locations and functional descriptions of all controller indicators or CRT displays.

7) Troubleshooting. A list in tabular format of all symptoms, probable causes of malfunction or improper operation, and probable remedies to the smallest board replaceable components.

3. Preventive Maintenance Instructions. These instructions shall include all applicable visual examinations, hardware testing, and diagnostic hardware/software routines. Instructions on how to load and use any test and diagnostic programs and any special or standard test equipment shall be an integral part of these procedures.

4. Corrective Maintenance Instructions.

a. These instructions shall include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction. These guides shall explain how to use on-line test and diagnostic programs for all devices and any special test equipment, if applicable.

b. The corrective maintenance instructions shall include:

1) Explanations for the repair, adjustment, or replacement of all items, including printed circuit cards. Schematic diagrams of electrical, mechanical, and parts location, illustrations, photographs, and sectional views giving details of mechanical assemblies shall be provided as necessary to repair or replace equipment. Typical signal waveforms, logic levels, bit patterns, etc., shall be included. For mechanical items requiring field repair, information on tolerances, clearances, wear limits, and maximum bolt-down torques shall be supplied. Information on the loading and use of special offline diagnostic programs, tools, and test equipment, as well as any cautions or warnings which must be observed to protect personnel and equipment, shall be included.

2) A list of test equipment and special tools required.

3) A list of all abbreviations and circuit symbols used.

4) Warranties, bonds and maintenance records, including proper procedures in the event of failures and instances which might affect the validity of warranties, bonds, or contracts.

5) A parts catalog enumerating every part to the lowest of card replaceable components. The description shall include component symbol, description, ratings, accuracy, manufacturer's name and address, manufacturer's part number, commercial equivalents, and quantity per assembly or subassembly. The parts catalog shall identify the appropriate locations of the parts and shall group each component by assemblies or subassemblies within each subsystem so that each component can be identified as being part of the next larger assembly.

6) A list of recommended spare parts that includes all parts necessary to maintain and repair control system components. The list shall identify the specific part or model number, description, manufacturer's name and address, commercial equivalents, unit price, lead time for delivery, and recommended quantity. The spare parts list shall indicate which components (by model and serial number) have been provided with the delivered system as part of the spares inventory.

5. Drawings.
   a. O&M Manual drawings (with the exception of those provided by third-party manufacturers) shall not be larger than 11 inches by 17 inches and shall be clearly legible when reproduced using conventional office copying machines. Originals shall be provided for all third-party O&M Manual materials. One reproducible of the O&M Manual drawing original must be supplied for each O&M Manual drawing larger than 11 inches by 17 inches, and must satisfy all drawing requirements specified herein. Those preprinted O&M Manual drawings which are not acceptable, or which must be modified or corrected to show the actual as-built design, shall be redrawn as new specially-prepared shop drawings. Acceptable equipment manufacturer's drawings incorporated into equipment operating and maintenance manuals need not be duplicated or removed from the manuals.
   b. Furnish drawings on paper, electronically as Adobe PDF files, and in the latest AutoCAD electronic format. Electronic files shall be submitted in CD or DVD format.
   c. Each O&M Manual shall be bound in 8-1/2-inch by 11-inch, 3-ring side binders with commercial quality hardback, cleanable plastic covers. Maximum of 3-inch binder size. An electronic copy of the O&M Manual shall be submitted in CD or DVD format.
   d. Binder covers shall contain the printed title:

      OPERATION AND MAINTENANCE INSTRUCTIONS
      [OWNER'S NAME]
      [PROJECT NAME]

   e. The manuals shall be internally subdivided with permanent page dividers with tab titling clearly printed under reinforced laminated plastic tabs.
   f. Each volume shall have a Table of Contents, with each product or system description identified.
6. Software Manuals. Supply original OEM O&M manuals for those standard OEM software packages provided under these drawings and specifications. Supply O&M manuals for the application software developed for these contract documents.

E. Record Documents.

1. After successful Site Demonstration Test, submit for review the Record Documents (as-built) for all equipment and software installed by the Contractor. All documents which have changed because of the engineering changes, contract changes, or error or omission shall be updated and the revised documentation provided.
2. Furnish complete as-built sets of:
   a. Source tapes, disk pack(s) or other storage media for all custom programs.
   b. Loadable and executable object disk pack(s) of the software systems.
   c. All previously delivered documents, with as-built updates.
   d. OEM standard documentation.
3. These media shall include the operating systems, all programs necessary for the operation as well as maintenance of the system, and all programs supplied by the CPU/microprocessor manufacturers, such as assembler, loaders, editors, compilers and diagnostics.
4. The documentation as outlined in this portion of the document, in conjunction with other documentation specified elsewhere in this document, shall be sufficient to allow the Owner to reconfigure or make additions or deletions to the system without assistance from the Contractor.

F. Testing Documentation Submittals. Submit testing plans to meet the requirements listed in Part 3 - Execution of this section and the subsequent reports resulting from the testing. The following paragraphs describe the general content of each submittal.

1. System Test Plan. The system plan describes the overall system testing. As a minimum, the plan shall include the general objectives of the test; the delineation of responsibilities of the Owner, Engineer, and Contractor during the test; any initial coordination issues; the location of the testing; a general description of each phase of testing or subsystem test; a description of the expected results; and a description of the procedures for the tracking of the test procedures, as well as any issues and problems that might result from the testing. This plan does not list the specific test procedures.

2. Test Procedures. This test plan is a document that lists the specific tests. Each test should include a description or listing of any setup requirements, the test procedure, and the expected results.
3. Test Reports. The test reports are the documents prepared during the actual testing. These reports shall also include any documentation of any problems and the resolution of those problems.

PART 2 - P R O D U C T S

2.1 INFORMATION ON DRAWINGS

A. Include the following information at a minimum on the drawings:

1. Loop diagram on flow sheet for each control loop. Diagrams are schematic in nature and intended only as a guide to work to be performed.
2. Approximate location of primary elements, instrument panels and final control elements.
3. Approximate location of instrumentation power junction boxes for instrument electrical power connection.
4. Location of electrical distribution panelboards for instrument electrical power.
5. Location of equipment having alarms and equipment status contacts.
6. Location of equipment being controlled by system.
7. General layout of instrument cabinets.
8. Instrument installation details.

B. The following information is not shown on drawings but shall be the responsibility of the Contractor to determine, furnish and coordinate with other Divisions, based upon systems specified. Show this information on project Record drawings.

1. Instrument loop drawings per ANSI/ISA S5.4 minimum, desired and optional items.
2. Location of electrical distribution panelboards supplying power to any device supplied under this contract.
3. Detailed enclosure and instrument panel layouts, fabrication details and wiring diagrams.
4. Detailed system configuration.
5. Raceway and cable routing for instrumentation wiring.

2.2 OPERATING CONDITIONS

A. Ambient Conditions. Provide equipment suitable for project ambient conditions specified. Provide system elements to operate properly in the presence of radio frequency fields produced by portable RF transmitters with output of 5 watts operated 24 inches from instruments; in the presence of plant telephone lines, power lines and electrical equipment; and in the presence of digital data transmission systems.

B. Field Locations. Field equipment may be subjected to ambient temperatures from -5 to 50°C with direct radiation, relative humidity from 0 to 100 percent with condensation.

C. Power Supply. Power supply will be 117 volts AC, single-phase, 60-hertz commercial power. Voltage variations will be at least plus or minus 8 percent. Ensure that analog signal loops incorporate adequate power supply capacity for operations.

2.3 TRANSIENT AND SURGE ISOLATION

Protect all power and communication and transmission/ receiving circuitry from any surge, including spikes up 1,000 volts peak and surges with a rise time of less than one microsecond. Use a combination of current limiting resistors, zener diodes, gas tube surge arresters, and a fusible link which melts and shorts the surge to ground before the device circuitry is affected. Provide protection adequate for personnel safety, which will prevent an erroneous output, change in calibration, or failure of component other than fuse or fusible link.

2.4 SPARE PARTS

When required spare parts are utilized during construction to correct a faulty condition, replace spare part in kind.

2.5 SPECIAL TOOLS

Supply one of each type of special hand tool required to open or operate equipment, to remove or replace replaceable parts, remove or replace cable connectors, or to make required operational or maintenance adjustments. A special hand tool is any tool not readily available from local retail hardware stores.

2.6 TEST EQUIPMENT

Provide a complete list of all tools, test equipment, and commercial software programs necessary for the proper maintenance of the system. This list shall contain the quantity recommended, model number, description, cost, and name and address of supplier.

2.7 MATERIALS AND EQUIPMENT

A. Materials. Material shall be new, free from defects, and of the quality specified. All instruments with the same specification shall be from the same manufacturer.

B. Equipment.

1. Provide equipment of solid-state construction utilizing semiconductors available from two or more sources, unless otherwise specified. Derate components to ensure dependability and long-term stability. Provide printed or etched circuit boards of glass epoxy, hand or wave soldered, of sufficient thickness to prevent warping. Where indicated, printed circuit boards in field-mounted equipment shall be covered with a conformal coating to protect against corrosion. Alignment and adjustments shall be non-critical, stable with temperature changes or aging, and accomplished with premium grade potentiometers or electronically with settings stored in non-volatile memory. Do not insert components of specially selected values into standard electronic assemblies to meet performance requirements. Use parts indicated in instruction manuals, replaceable with standard commercial components of the same description without degrading performance of completed assembly. Use edge connectors and pins with phosphor bronze contacts with gold-plated mating area.
2. Use test equipment and instruments to simulate inputs and read outputs suitable for purpose intended and rated to an accuracy of at least five times greater than the required accuracy of device being calibrated. Test equipment shall have calibration traceable to NIST.
3. Equipment located in hazardous areas shall be suitable for applicable classification by use of either explosion-proof housings or by equipment and barriers being approved as “intrinsically safe” by either UL or FM. Locate barriers in cabinets outside the hazardous area. Use dual barriers in loops in order to prevent grounding loop at the barrier.

2.8 Human Machine Interface (HMI)

A. Provide an HMI utilizing VTScada version 11.x to match the City standard. Provide a thin client version for all panel mounted HMIs shown in the Connection Diagrams.

PART 3 - E X E C U T I O N

3.1 SPECIAL PROJECT REQUIREMENTS

A. Coordinate with all the sub-systems suppliers and manufacturers, during bidding, construction, testing, installation and start-up phases of the project. The coordination is to assure that the instruments, and sub-systems are in compliance with the specifications and the central controls, and that the tie-ins and the interface signals are provided as required.

B. The calibration, testing and start-up of all the instruments shall be done by the manufacturer's field technician/engineer in the presence of the Owner. Provide a list of all manufacturers whose technician will perform this work. Provide a certified calibration report stating that each instrument has been installed per manufacturer's recommendations and per these specifications.

3.2 SYSTEM DESIGN

A. Provide all the necessary hardware, software and program development to satisfy the instrumentation and control system described in the contract documents.

B. Prepare design submittals for 30, 60 and 90 percent design levels for review by the Owner. These design submittals shall be in accordance with the Submittals article of this specification.

C. Configure and program the control system to meet the functional and performance requirements of the contract documents. This shall include the development of:

1. System point input/output list.
2. Control logic to implement the control strategies described in the contract documents.
3. Configuration and programming of the field units with the control logic.
4. System database and point naming (tagging) conventions.
5. Development and implementation of custom operator interfaces and screens.
6. Configuration and implementation of the system reporting to include alarm configuration and reporting.
7. Design, configuration, and any programming of the system communication network.

D. Install, connect, tune and perform all necessary startup of the system in accordance with the contract documents.

E. Perform all system testing described in the System Test Requirements article of this section.

3.3 INSTALLATION AND STARTUP

A. Install the new equipment in accordance with the drawings and specifications.

B. Coordinate with the Owner to keep the Owner processes operating during the installation and cutover phases of the project. Any outages required shall be requested in writing with the Owner and approved at least 24 hours prior to the start of the outage.

C. Provide any temporary power and/or controls necessary to keep the Owner's processes operating during the installation of the new equipment.

D. Coordinate any startup testing of new equipment with the Owner prior to the actual testing. Startup testing is defined as any Contractor test to verify to the Contractor's satisfaction that the new equipment has been installed in accordance with the manufacturer's recommendations and the drawings and specifications. Testing shall not be a substitute for the formal testing listed under Article 3.4, System Test Requirements of this specification.

3.4 SYSTEM TEST REQUIREMENTS

A. General Requirements.

1. The control system shall undergo a comprehensive system test process to demonstrate that the system performs as an integrated unit to meet the requirements of this specification. As a normal course of system development, conduct all element, subsystem, and system tests necessary to ensure the proper operation of the control system at various stages of system development. This type of testing normally will not be

witnessed; however, the Owner and Engineer reserve the right to witness these tests if concerns arise about the progress of system implementation.

2. Three formal, witnessed tests shall be conducted on the control system:
   a. Factory Demonstration Test.
   b. Field I/O Point Checkout.
   c. Field or Site Acceptance Test.
3. The following paragraphs describe the requirements for each of these formal tests.

B. Factory Demonstration Test (FDT).

1. The FDT and verification for all equipment, software, and associated documentation shall be performed prior to system, subsystem, or major components shipment. The tests shall be performed to verify that the equipment is manufactured and assembled correctly, is operating as designed, and is in compliance with the contractual documents. The tests shall be performed to verify also that the software and hardware will meet the functional and performance requirements of the contract documents. The Owner and the Engineer will witness these factory tests. The supplier of the control system shall provide the following for the Owner and the Engineer.
   a. Notification 4 weeks in advance of the tests.
2. The FDT shall demonstrate compliance to the stated requirement in the specification. Use the approved Factory Demonstration Test plan submitted under Article 1.6 of this specification.
3. The FDT shall include the following:
   a. Equipment Test and Verification. The FDT for the equipment (hardware) test and verification shall include individual end-item verification and integrated tests of all hardware. These tests shall include visual inspection verification and running the standard hardware diagnostic programs, plus all special diagnostic programs used by the Contractor to demonstrate that the hardware integration task has been completed.
   b. System Functional Test. The FDT for the system functional test shall exercise every specified system function and shall include, but not be limited to, the following:
      1) Rigorous exercising of all devices both individually and collectively.
      2) Verification of proper scanning and data acquisition of status and data points.
      3) Demonstration of all redundant functions and components.
      4) Demonstration of all required data base management functionality.
      5) Demonstration of all required software support utilities.
      6) Demonstration of all system diagnostics, both on-line and off-line.
   c. Project Application Software Tests. The FDT for the project application software shall demonstrate to the best extent possible, the proper functioning of the application control logic implementing the control strategies for this project. These tests shall include:
      1) Control logic response to both field inputs, operator changes, and any interlocks.
      2) System event and alarming.
      3) Trending of variables.
      4) System reporting.
      5) System redundancy.
   d. Support Software Tests. The FDT for the support software shall include the following, as a minimum:
      1) Demonstration of system editing capabilities including the addition and deletion of points in a PLC; the addition, deletion, and modification of HMI displays; the addition, deletion and modification of report formats; the addition, deletion, and modification of control strategies; and the modification of the database and all database parameters.
      2) Demonstration of the editing of all system parameters including timers, intervals, etc.
      3) Demonstration of utility software facilities, including assembling, compiling, appending, downloading and uploading of programs. On-line programming and debug facilities shall also be demonstrated.

C. Field I/O Point Checkout.

1. An I/O point-to-point test shall be performed after all equipment is shipped and installed in the field. This is an end-to-end test to verify that the equipment has been installed correctly.
2. The Owner and the Engineer will witness these field tests.
3. The I/O point checkout shall demonstrate the proper operation of all the field points affected by the installation of the equipment provided by this contract.
4. Provide a printed I/O list for all signals to be monitored and controlled under this contract with sign-off space, space for test results and space for notes for each signal.
5. The I/O point checkout shall include, but not be limited to, the following:
    a. Exercise each discrete input. Each state shall be verified at the field unit and the operator workstation.
    b. Exercise each analog input. Each input shall be verified at 0, 25, 50, 75, and 100 percent range of the instrument. Linearity of the signal shall be verified. Each value shall be verified at the field unit and operator workstation.
    c. Exercise each discrete output. Each state shall be initiated from the operator workstation. If necessary, the associated equipment shall be placed into a "safe" state such that the activation of the output will not damage the equipment or cause a safety hazard.
    d. Exercise each analog output. Each output shall be verified at 0, 25, 50, 75, and 100 percent range of the instrument. Linearity of the signal shall be verified. Each value shall be initiated and verified at the operator workstation.
    e. Unless constrained by the operation of the plant or due to safety reasons, all testing, except for the analog input tests, should include the actual equipment and not use simulated signals.

D. Field or Site Acceptance Test.

1. Conduct a site acceptance test to demonstrate the proper implementation, installation and startup of the control system logic and software using the actual devices and plant equipment.
2. Conduct this test in accordance with the approved test plan submitted under Article 1.6 of this specification.
3. This test shall include, but is not limited to, the following:
    a. Demonstrate the communication between the local operator interfaces and field units.
    b. Demonstrate communication between the control room and field control units.
    c. Demonstrate any peer-to-peer communication.
    d. Demonstrate the ability to upload, modify and download control logic to field control units.
    e. Demonstrate that the control logic and programming has been installed and implemented in accordance with the project control strategies and contract documents. This test shall demonstrate this on a subsystem, then system-wide basis.
    f. Demonstrate the plant equipment responds properly to operator commands.
    g. Demonstrate any plant interlocks function properly and in accordance with control strategies and contract documents.
    h. Demonstrate system reporting and proper report formats.
    i. Demonstrate system event and alarming functions in accordance with the approved design and contract documents.
    j. Demonstrate trending of system points both real time and historical.
    k. Demonstrate system redundancy.

3.5 TRAINING

A. Conduct the following training:

1. Operator Training.
    a. The objective of operator training is to provide the Owner's operational personnel with the knowledge necessary to properly use the new equipment to perform their day-to-day duties as plant operators.

b. A combination of classroom and field training shall be provided, as required to sufficiently comply with all training requirements. In general, training shall be limited to one 8-hour day, unless otherwise necessitated to sufficiently complete required procedures outlined herein.
c. Operator training shall utilize the project O&M manuals as a basis for this training.
d. Submit to the Owner a course outline or syllabus and training material for the topics to be covered in operator training.
e. Operator training shall occur prior to the system being placed into operation.
f. As a minimum, operator training shall include but is not limited to:
1) Operation of the plant and process equipment from HMI equipment in the main control room and any remote control areas.
2) Operator response to alarms and feedback displays.
3) Trending of system variables.
4) HMI screen navigation functions.
5) Types of HMI control functions used and the operation of each (i.e. radio buttons, sliders, data entry points, etc.).
6) General functioning of the communication network.
7) Graphic screen displays in the HMI (i.e. types, information displayed on each, etc.).
8) Alarm (acknowledging and alarm history) and event functions.
9) Reporting functions (configuring, scheduling, and running reports).

2. Maintenance Training.
a. The objective of maintenance training is to provide the Owner's maintenance personnel with the knowledge necessary to properly perform maintenance activities on the system to include preventive and corrective maintenance.
b. A combination of classroom and field training shall be provided, as required to sufficiently comply with all training requirements. In general, training shall be limited to one 8-hour day, unless otherwise necessitated to sufficiently complete required procedures outlined herein.
c. Wherever possible, the Owner's maintenance personnel shall be involved in the startup and testing of the system in order for them to get oriented to the system.
d. Maintenance training shall utilize the project O&M manuals as a basis for this training.
e. Submit to the Owner a course outline or syllabus and training material for the topics to be covered in maintenance training.
f. As a minimum, maintenance training shall include but is not limited to:
1) Preventive and maintenance schedule(s) shown in the O&M manuals.
2) General functioning of the communication network and troubleshooting of communication errors.
3) Functioning of field equipment, instruments, and HMI equipment.
4) Use of any diagnostic software provided with the system.
5) Use of any special tools provided with the system.
6) Instrument calibration procedures and schedules.

B. The Contractor has the option of utilizing manufacturer training personnel to meet the requirements of the operator and maintenance training.

END OF SECTION

SECTION 13405

CONTROL SYSTEM OPERATION

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the connection of field instrumentation and control system equipment, in order to facilitate the implementation of a fully operational control and monitoring system, as described in this section.

B. Connect vendor-supplied equipment packages with self-contained control systems to the plant monitoring system through outputs from the vendor-supplied equipment packages. The operation of these systems and processes shall be as illustrated schematically on the drawings.

1.2 QUALITY ASSURANCE

A. Requirements Include:

1. Acceptable manufacturers for the component parts of the control system are indicated and specified in individual specification sections.
2. All equipment will be of the latest and most modern design and shall perform as guaranteed by the manufacturer or as specified herein, whichever is greater.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CONTROL SYSTEM SCOPE

A. The project will be set up for SCADA monitoring. All data acquisition functions shall be performed by Programmable Logic Controllers (PLC) distributed throughout the site. The PLCs shall be as specified in Section 13410, Programmable Logic Controllers (PLC).

B. The basis of the process control system in this facility shall be industrial quality equipment as defined by the individual specification sections.

C. The plant control system is designed for local operation at each piece of equipment and for monitoring through the operator's consoles. Automatic operation will be based upon the local control panels furnished with the major process equipment items by the equipment vendors, or by as systems integrator, and meeting the requirements of individual specification sections.

D. All control system design and installation shall consider the protection of personnel and equipment as paramount. Contact (discrete) inputs shall be configured for fail safe operation; i.e., an open contact shall cause an alarm condition in the control system.

E. Alarms shall latch until reset by the operator locally at the control panel or through the plant SCADA system.

3.2 HEADWORKS OPERATION

A. General. The control system will contain the equipment and logic for proper operation of the headworks equipment including all start up, shutdown, and safety interlock logic.

B. Mechanical Fine Screens and Compactor Washer: The operation of the screens and compactor washer will be governed by a single Hand/Off/Auto switch for the entire unit. The screens and compactor washer will normally operate in Automatic mode. If an alarm sounds on the screen or washer compactor they must be inspected. There will be no remote operation or of these devices through the SCADA system. Automatic control shall be dependent on a timer or differential level across the screens. In hand mode the screens will run continuously once started by the operator until stopped. Washer compactor operation shall be interlocked to operation of the screens.

1. The vendor of the screens and compactor washer shall provide the local control panel. The plant supervisory SCADA system or auto dialer shall be able to monitor run status of both the screens and the compactor-washer, as well as the status of spray wash systems, emergency stop, and fault status. The screens and compactor-washer shall not run when any emergency stop push button is activated.

a. In the System Hand mode, each screen must all be manually stared or stopped using their local Start/Stop push buttons.

b. In the System Off mode, neither the screens nor the compactor washers shall operate.

c. In the System Auto mode, the screens may be individually selected for automatic operation using a Hand/Off/Auto selector switch.

1) In System Auto mode and a local screen in Hand mode, each screen may be individually started and stopped via the local Start and Stop push buttons. Associated compactor washer operation shall be automatically interlocked to screen start. When either screen is started in Hand mode using the Start pushbutton, the associated washer compactor shall be started in its normal sequence. Conversely, when both screens are stopped using the Stop pushbuttons, the compactor washers will also stop.

2) In System Auto mode and a local screen in Off mode, the screen will not run.

3) In System Auto mode and a local screen in Auto mode, the screen and compactor washer operations are automatically controlled by the settings in the local control panel.

a. In Auto-Auto mode, a Time/Level switch will allow the operator to choose the method of control.
b. Time operation bases the operation of the screen on a timer set by the operator. With the screen in the Timed mode, the screen will run periodically (interval based upon the operator entered value) for a complete cycle.
c. Level operation will start the screens based upon a preset differential level across the screen. This preset differential level will be selectable in the vendor supplied control panel via an adjustable switch which receives its input from the upstream and downstream level transmitters.
d. The associated compactor washer will turn on when a screen turns on and shall run for a timed period after the screen has turned off. A solenoid valve will open, and wash water will flow to the compactor washer when running.

4) No Control points shall be provided on the plant SCADA HMI or auto dialer for the mechanical screens.

5) Indicating Displays at the combined screen and washer compactor control panel:
a. Screen Upstream Level

6) Alarms at the combined screen and washer compactor control panel and on the autodailer:

a. Screen Fault Alarm
b. Compactor Fault Alarm

7) Screen failure to start shall be alarmed locally and in the plant SCADA system and auto dialer.

d. Emergency Stop: When any of the Emergency Stop pushbuttons or pull cords are activated, the screen, compactor-washer, and spray washes will stop immediately. The control power light will be de-energized. To reset, all Emergency Stops must be enabled, and the Reset button depressed. If power is interrupted, the equipment may restart automatically once power is restored. Pressing the reset button after a power outage will not be required.

2. Plant SCADA system.

a. The plant SCADA system will have the ability to monitor the status of the screens and compactor-washer. Monitoring points shall include:

1) Elapsed run time (SCADA timer with digital inputs for activation)
2) Screen alarm
3) Compactor-Washer alarm
4) Channel High Level
5) Screen wash water solenoid valve position (open or closed)
6) Compactor washer wash water solenoid valve position (open or closed)
7) Control power on
8) Screen running (each screen)
9) Compactor washer running
10) Compactor Washer Manual Screen Feed Door Open
11) Emergency Stop (for each emergency stop switch)
12) Mechanical Fine Screen System Reset
13) Screen Auto position indication
14) Compactor-Washer Auto position indication
15) Screen upstream level (each screen)

b. The auto dialer will have the ability to monitor the status of the screens and compactor-washer. Monitoring points shall include:

1) Screen alarm
2) Compactor-Washer alarm
3) Channel High Level
4) Control power on
5) Screen running (each screen)
6) Compactor washer running
7) Compactor Washer Manual Screen Feed Door Open
8) Emergency Stop (for each emergency stop switch)
9) Mechanical Fine Screen System Reset
10) Screen Auto position indication
11) Compactor-Washer Auto position indication
12) Screen upstream level (each screen)

C. Grit Removal. The Grit removal units have solenoid valves which operate intermittently and assist with fluidizing grit movement to the classifier. These are operated from a single panel supplied with the grit unit. This control panel will use 120V to power for a programable relay to operate the two solenoid valves associated with this unit.

1. The control cabinet for the grit removal units shall have two timers with outputs to control the solenoid valves associated with the grit units GRU-211 and GRU-212.

D. Grit Classifier. The vendor of the classifier shall provide a local control panel. The grit classifier will run continuously. There is no need for the operators to have remote control of this device. Run/Stop push buttons are provided at the Grit unit control panel. Classifier speed will be manually controlled through a VFD located within the supplied cabinet.

1. Control points shall be provided on the plant SCADA HMI to allow monitoring of the following:
a. Run/Stop Status

b. Grit classifier run time

2. Control points shall be provided on the plant auto dialer to allow monitoring of the following:

a. Run/Stop Status

3. Wash water dwell time and wash water on time will be set by mechanical timers. All other control functions will be accomplished using relay logic with electromechanical relays. No PLCs shall be used.

3.3 ACTIVATED SLUDGE SYSTEM OPERATION

A. General. The control system will contain the equipment and logic for proper operation of the activated sludge system equipment including all start up, shutdown, and safety interlock logic.

B. Basin Configuration

1. There is a mix box which combines RAS and Raw influent flow and distributes this flow to two parallel trains (or basins). Each train consists of an anaerobic selector zone and three aerobic (or oxic) zones. Of the three aerobic zones, the first has a higher diffuser density than the second and third. All aerobic zones have independent air drops to their respective aeration grid. Each basin discharge over weirs to an effluent box and then flows to its respective clarifier. Flow over each effluent box weir may be blocked, isolating a clarifier. Flows from the fourth zone of each basin may be combined through a wall mounted sluice gate, allowing the flow of the two basins to be combined, and a single clarifier to be used for the total flow. Thus, a clarifier may be taken out of service while its basin remains in service. A sludge holding tank is provided for inventorying waste sludge onsite prior to hauling off site for processing.

2. Mix Box.

a. Mixing of RAS and Raw influent combine in the raw influent pipe prior to entering the mix box. Combining raw influent with RAS prior to introduction into the anaerobic zone provides an initial high concentration of organic load which is thought to be beneficial for developing a better settling sludge.

3. Anerobic Selector Zone

a. The anaerobic zone will be periodically mixed using course bubble diffusers.

b. ORP probes shall provide the operator with indication of reduction potential in the anaerobic zones. A low reduction potential is an indication of anaerobic state, which the operator can use to assist in determination of length of course bubble mixing in the anaerobic zone as well as frequency of mixing.

c. Instrumentation:

1) ORP (AE-310A and 320A). These instruments shall provide an indication of reduction potential in the anaerobic zones as a surrogate for anaerobic state.

2) On/Off Valves. These motor operated valves will start and stop air flow for mixing into each anaerobic zone. Travel stops on the motor actuator will allow flow to be limited so that the air flow in the ON state may be limited.

a. Basin T-301 KV 310A,

b. Basin T-302 KV 320A,

c. In the Local position, the valve may be opened and closed, unaffected by any HMI generated interlocks via Open and Close pushbuttons on the valve actuator.

d. In the Off position, the valve will not move, it will remain at its last position.

e. In the Remote position, the valve operation is controlled by the Master Control Panel MCP-B.

i. The following control points shall be provided on the plant SCADA HMI for each Valve:

Valve position (Open/Closed)

d. Control description:

1) The valve actuators will be controlled from the blower master controller MCP-B. Only one anaerobic zone in one basin shall be mixed at any time, mixing shall be sequenced so that

each basin is mixed in succession until all anaerobic zones in all basins have been mixed. The operator shall have inputs from the SCADA system to provide frequency of mixing per day, and length of a mixing cycle. The flow of air to each anaerobic zone shall be limited by a travel stop in the control valve actuator.

2) Flow of air to the sludge holding basin shall be interlocked to operation of KV-310A and 320A preventing flow of air to the sludge holding basin when either of these two valves is open.

3) Blower speed may be adjusted automatically when either 310A or 320A is opened to ensure that the required amount of mixing air is delivered to the anaerobic selector zone.

4. Aerobic Zones

a. Each aeration train (basin) shall have a modulating control valve to regulate flow. This modulating control valve shall be of the eliptical orifice type having roughly linear characteristics. Each anaerobic zone of a basin shall have an on/off eccentric plug control valve to allow periodic air mixing of the zone. Each of the three aerobic zones of a basin shall have a manual valve to manually control air flow to each drop when air is flowing to the train. In the base design this valve shall be of the butterfly type. As an alternate, these valves shall be of the eccentric plug type allowing the operator to better manually tune the distribution of air to the three zones. If the alternate is chosen, these manual valves must be furnished with position indicators.

5. Sludge Holding Tank

a. The sludge holding tank will inventory WAS onsite until wet hauled for off-site processing. The tank will be mixed and aerated with a jet mixing system. The pump for the jet mixing system will utilize a submersible pump operating at a constant speed. Air will be supplied from the same blowers used for the two aeration trains. The sludge holding tank may also be decanted to increase solids in the sludge holding tank and provide longer times for inventorying solids.

b. Instrumentation:

1) A level transmitter, LE-416 shall be provided so that the operator can monitor the liquid level in the tank. A separate level float device, LSHH-416 shall be provided to alarm the operator if the liquid level has reached a critical level

2) A flow element, FE-331 shall be provided so that the operator can monitor the air flow to the tank.

3) A flow element, FE-410B shall be provided so that the operator can monitor the flow of solids being wasted.

4) A timed valve, KV-414 shall be provided so that the flow of WAS can be controlled into the sludge holding tank by the operator.

6. Blowers and Valves – Two screw blower will provide air for the aeration trains and the sludge holding tank. All blowers will be connected to the automatic control system (the master control panel MPC-B) but may be monitored through the plant SCADA system and the auto dialer. Each blower will be supplied with a local control panel to allow local manual control. In automatic mode, blowers will be controlled through an intelligent blower control algorithm at the master control panel level (designated MCP-B). There should be a hot standby PLC provided in MCP-B. The blowers must be able to function upon failure of MCP B. The operators must have the ability to set valve positions and blower output(s) manually upon failure of the master controller.

a. The blowers will normally operate in Automatic Mode. Blower control should be two-tier (master/slave). The Master Control Panel MCP-B should have the algorithms that instruct each individual blower where it should operate on its curve and direct each valve as to the percent open it should be based on the D.O. setpoint. The operator shall be able to select which DO signal (which zone) is used for control. Additionally, if the controller is unable to reduce air flow low enough to maintain the D.O.

setpoint, the controller shall be able to turn off and cycle the blowers to further reduce the air flow rate. In this case the operator will be able to select the total cycle duration and either the on or off time.

b. Instrumentation:

1) Dissolved Oxygen. These instruments will serve as the process variable in the air flow control loops used to monitor the dissolved oxygen level in each aerobic (oxic) zone of the basins. Aeration will be controlled by setpoints of the dissolved oxygen concentration in the aeration basins. The operator will choose which D.O. analyzer is to be used for control.

a. Basin T-301: AE 301B, 310C, and 310D D.O. analyzers
b. Basin T-302: AE 320B, 320C, and 320D D.O. analyzers

2) Air Flow Rate – Aeration Basins: Flow meters will be provided for the total flow to each basin, and for each aerobic zone. A flow rate for the anoxic zones will not be provided, but this flow will be calculated a difference between the total flow to the basin and the sum of the flows to the aerobic zones.

a. Aerobic (oxic) zone drops
   i. Basin T-301 FE-312, FE-313, and 314
   ii. Basin T-302 FE-322, FE-323, and 324
b. Total air flow to each basin
   i. Basin T-301 FE-311
   ii. Basin T-302 FE-321

3) Air Flow Rate – Sludge Holding Tank: This thermal flow meter will provide measurement of the air flow to the Sludge Holding Tank.

a. Tank T-304 FE-331

4) Air Flow Rate – Total Blower Discharge: This calculation will be made by summing the rates from FE-311, FE-321 and FE-331. This calculation in conjunction with the total of the meters to the individual drops, will be used by the master controller MCP-B to determine the necessary blower output.

5) Air Flow Rate – Each Blower: The output of each blower can be calculated or mapped based on the speed of the blower. The speed of the blower shall be calculated based on the variable frequency drive output.

6) Air Pressure – Blower Discharge Air Header: This pressure transducer will be available for use by the master controller MCP-B to determine the necessary blower output.

a. Blower Discharge Air Header Pressure - PE-302

7) Flow Control Valves – These motor operated valves will modulate the air flow into each basin using a most open valve control scheme. The operation of the valve will be governed by the position of the Local/Off/ Remote selector switch for each valve.

a. Basin T-301 FCV 310,
b. Basin T-302 FCV 320,
c. In the Local position, the valve may be opened and closed, unaffected by any HMI generated interlocks via Open and Close pushbuttons on the valve actuator.
d. In the Off position, the valve will not move, it will remain at its last position.
e. In the Remote position, the valve operation is controlled by the Master Control Panel MCP-B.

c. Control description:

The D.O. concentration, monitored in each basin zone, will be one input used to control air flow into the two basins. Each of the three aeration zones in each of the aeration basins will have a D.O. probe. Only one zone will be used for control of air flow to a basin at a time, and the zone to be used will be selected by the operator. Each basin will use the identical zone for control.

1) The integrator shall be skilled in aeration control and shall be responsible for integrating blower and aeration control and procuring or providing programing algorithms needed. These algorithms shall be non-proprietary, open source.

2) Automatic operation will use a constant D.O. setpoint strategy. Mass flow from the individual blowers will not be directly measured, mass flow rate will be inferred from blower speed, ambient temperature and humidity. Total air flow from the blower header will be calculated as described above. It can be assumed that identical blowers running at the same speed will provide equal flow.

3) Constant D.O. Control: D.O. will be maintained by motor actuation of the modulating valve to each basin and by blower speed control. A most open valve control philosophy will be used in combination with a non-PID control strategy. If a proprietary vendor control strategy is proposed, a non-proprietary floating-point control strategy must also be programmed into the MCP-B and be selectable for use by the operator. The floating-point control shall have options for:

a. Timed response of delay between corrections
b. Direct acting logic
c. Proportional speed control with the change in air flow proportional to the error in D.O. concentration
d. Deadband – typical initial deadband 0.2 to 0.3 ppm (tolerance = +/- 0.1 to +/- 0.15%)
e. Biased response (initial air flow changes on decreasing air flow (D.O.) an adjustable percentage (initially 60%) of the changes on increasing air flow (low D.O.)
f. Rate of change inhibiting the control response (minimum rate of change approximately 0.1 to 0.15 ppm/min)

4) The initial approximations above for tuning must be modified during commissioning. Refer to Thomas E. Jenkins "Aeration Control System Design" for floating point design considerations and commissioning.

5) The two DO probes in each basin not selected for control will be used for monitoring.

6) If any zone has been online while a flow rate to that zone has been below an operator set value for minimum mixing, for an operator-defined maximum amount of time, the air control valve to that basin will be actuated to open to provide the minimum mixing air flow for an operator-defined amount of time. This control will not be dependent on any D.O. concentrations and will override any D.O. control. Upon completion of this mixing time cycle, the system status will reset, allowing for the resumption of D.O. control described in this section.

7) High DO Management

a. System shall include a High DO mode to allow for control during high DO/low loading periods (typically occurring overnight)

i. When enabled and active, the system will allow for blowers to be unloaded periodically, effectively cutting off air to the controlled process

ii. High DO will activate when the following conditions are true:

Blower system is operating in a minimum output state (minimum number of blowers running at minimum speed)

Averaged DO values have exceeded the averaged DO setpoint for the process for a user-defined time period, by a user-defined amount.

High DO mode operation is allowed by the operator

8) High DO will deactivate when any of the following conditions are true

a. A user defined period has elapsed

b. Average DO values fall within a user defined deadband of the average setpoint

c. A user disallows or deactivated High DO mode

9) When High DO is deactivated, regular DO control operation shall resume, and blowers will be loaded back into service restoring aeration to the process

10) The above described High DO mode can be enabled or disabled, allowed or disallowed by the user

a. Allowing High DO mode allows for the system to automatically enter and leave High DO mode as stipulated above

b. Enabling or disabling High DO mode will force the system to enter or conclude a High DO mode cycle

11) To prevent diffuser fouling, an automatic cycle to flex the diffusers shall be programmed into the Master Control Panel MCP-B to increase flow from the blowers to a specified value once per week. This air flow value will depend on the number of basins in service. Length of time of increased air flow for flexing shall be operator defined through the HMI. The operator may be required to adjust manual valves so that all zones receive adequate flow. A message reminding the operator of this shall be displayed.

12) The setpoint for air delivery from the blowers shall be controlled by the Master Control Panel MCP-B. The information from the local blower control panel, the other process information collected by the master control panel MCP-B, and the required setpoints for the blowers shall be programed and coordinated by either the Master Control Panel MCP-B vendor (if supplied with the blowers) or by the integrator. All data routed to the master control panel MCP-B and used for control or monitoring shall be available to be passed from the Master Control Panel MCP-B to the plant SCADA system through an ethernet connection.

13) If the dissolved oxygen level drops below the LOW DO alarm set point, the LOW DO alarm contact shall close and signal a LOW DO alarm.

14) The Master Control Panel MCP-B shall control the blowers based on a Lead, Lag, and Standby priority, and shall alternate blower use based on hours run. Desired alternation frequency shall be available as an operator input for the Master Control Panel MCP-B.

15) Flow regulation will be based on a calculation using the information about each blower (speed, flow) programmed into the Master Control Panel MCP-B1.

16) Set points will be assigned to the appropriate blower (lead, lag, or standby) as to the required flow at which it will come online and drop offline.

17) When an additional blower is needed, the Master Control Panel MCP-B shall coordinate the startup of the appropriate blower.

18) The minimum and maximum flow set points may be changed when the blowers are running.

19) The operator may change the lead, lag, and standby pattern using the HMI interface at the Master Control Panel MCP-B while the blowers are running, and the Master Control Panel MCP-B shall acknowledge and implement such changes.

20) Blowers shall restart automatically after loss of power when power is restored.

d. Indicating Lights at the Master Control Panel MCP-B:

1) System Power

7. Aeration Blowers.

a. The local (slave) blower control panel provided with the blowers will be responsible for blower protection.

b. The operation of the aeration blowers will be governed by the position of the Local/Off/Auto selector switch associated with each blower.

1) In the Local position, each blower may be started and stopped (unaffected by any HMI generated interlocks) via the Start and Stop pushbuttons on the local control panel.

a. Individual blower speed will be set though the blower's associated VFD.

2) In the Off position, the aeration blowers will not run.

3) In the Auto position, the blowers capable of automatic operation will be operated as directed by the Master Control Panel MCP-B.

a. The Master Control Panel MCP-B will direct the individual blowers to run at a speed to obtain the flow rate which the Master Control Panel MCP-B determines is needed.

c. The local control panel at each blower shall have the following components:

1) Panel Displays/Lights

a. Power to the blower
b. Local/Off/Remote mode
c. High motor bearing temperature
d. High motor winding temperature
e. High discharge pressure
f. High discharge temperature
g. High oil temperature
h. Low oil pressure
i. Filter differential pressure
j. Blower fault alarm

2) Devices associated with the blowers

i. Blower bearing temperature switch
ii. Discharge pressure transmitter (at each blower)
iii. Discharge temperature transmitter (at each blower)
iv. Lubrication oil temperature transmitter
v. Lubrication oil pressure transmitter
vi. Calculated flow rate from each blower (either by speed, or as fraction of total flow for identical blower running at the same speed)

3) Blower interlocks

a. High motor bearing temperature
b. High motor winding temperature
c. High discharge pressure
d. High discharge temperature
e. High oil temperature
f. Low oil pressure
g. Filter differential pressure

4) Alarms

a. If any of the above interlocks are triggered which causes a blower to shut down, it must be reset by the operator before a blower can restart.

b. The alarm interlock will be illuminated, along with the associated fault indicator.

d. Plant SCADA System or auto dialer

1) The following information shall be provided to the Master Control Panel MCP-B for display at its HMI, and communicated to the plant SCADA HMI or autodialer through the Master Control Panel MCP-B for the following:

a. Power to the blower
b. Hand/Off/Auto mode
c. Blower header pressure will be monitored by PIT-302 and displayed on plant SCADA HMI or auto dialer.
d. High discharge pressure
e. High discharge temperature
f. High oil temperature
g. Low oil pressure
h. Inlet filter differential pressure
i. Blower fault alarm

i. Blower failure to start shall be alarmed locally and in the plant SCADA system or auto dialer

j. High DO Management Status

2) The plant SCADA or auto dialer system will have the ability to monitor all devices and alarms associated with the Master Control Panel MCP-B.

e. Total blower header air flow will be calculated as described above and displayed on plant SCADA HMI or auto dialer.

f. Blowers will automatically restart after power failure and resume their last conditions.

g. HMI Panel

1) The Master Control Panel MCP-B will have all alarms, operator set points, system inputs, outputs and interlocks required for and DO blower control. These will be available for viewing and manipulation through screens on the HMI panel.

2) Devices associated with the Master Control Panel MCP-B:
   a. Main air header pressure PE-302
   b. Basin T-301 air flow rate zone 2 through 4 FE-312, 313, 314, and total header flow FE-311
   c. Basin T-302 air flow rate zone 2 through 4 FE-322, 323, 324, and total header flow FE-321
   d. Sludge holding tank air flow rate FE-331
   e. Basin T-301 air control valve FV-310 position
   f. Basin T-302 air control valve FV-320 position
   g. Basin T-301 DO AE-310B, 310C and 310D
   h. Basin T-302 DO AE-320B, 320C and 320D
   i. Hours of operation before blower alternation
   j. Aeration DO setpoint for continuous DO control
   k. High D.O. Management Control status
   l. High D.O. Management Control time
   m. Blower Lead/Lag/Stand-by configuration/status
   n. Minimum mixing air flow rate per basin
   o. Maximum air flow rate per basin (during no airflow to anoxic zone)
   p. Timers for anerobic zone mixing
   q. Timers for aerobic zone minimum mixing
   r. Timers for sludge holding tank mixing

3) Alarms
   a. Low DO Alarm
   b. High Discharge Pressure Alarm
   c. Blower B-401A Fault Alarm
   d. Blower B-401B Fault Alarm

h. Local Control Panels at Blowers will provide protection of individual blowers and basic information about the operation of the individual blowers.

1) Indicating Lights/Display

   a. Devices associated with individual blowers:
      i. Blower B-401A filter differential pressure
      ii. Blower B-401B filter differential pressure
      iii. Blower B-401A oil pressure
      iv. Blower B-401B oil pressure
      v. Blower B-401A oil temperature
      vi. Blower B-401B oil temperature
      vii. Blower B-401A speed
      viii. Blower B-401B speed
      ix. Blower B-401A inlet temperature
      x. Blower B-401B inlet temperature

xi. Blower B-401A inlet pressure
xii. Blower B-401B inlet pressure
xiii. Blower B-401A discharge pressure
xiv. Blower B-401B discharge pressure
xv. Blower B-401A discharge temperature
xvi. Blower B-401B discharge temperature
xvii. Blower B-401B Run Control (HOA and Start/Stop)
xviii. Blower B-401A Run status (on or off)
xix. Blower B-401B Run status (on or off)
xx. Blower B-401A operating hours
xxi. Blower B-401B operating hours

b. Interlocks

i. Alarm and shutdown on High Oil Temperature
ii. Alarm and shutdown on Low Oil Pressure
iii. Alarm on High Discharge Pressure
iv. Alarm on High Discharge Temperature
v. Shutdown on High-High Discharge Pressure

2) Plant SCADA or Auto Dialer System

a. The local control panel will communicate to the SCADA or auto dialer system through the Master Control Panel MCP-B. Loss of PLC functionality in the Master Control Panel MCP-B shall not prevent the SCADA or auto dialer system from being able to monitor the status of the individual blowers reported by the local control panels.

8. Clarifier Operation

a. General. The local control panel will contain the equipment and logic for monitoring the operation of the clarifier equipment.

1) Clarifiers shall be started and stopped though the activation of the local Start/Stop push buttons.

b. The operation of the clarifiers will be though local start stop controls.

c. Run status, including run time hours, torque (or amp draw), and high torque alarm for the clarifier will be monitored through the SCADA HMI.

d. A high torque switch for each clarifier will inhibit operation of the clarifier until reset. Status of the high torque alarm will be available through the SCADA HMI.

e. Local Control Panels

a. Indicating Lights
i. Run
ii. Stop
iii. High torque alarm
b. Devices associated with clarifiers
i. Mechanical torque switch at clarifiers
ii. Current transmitter (at MCC)
c. Interlocks
i. Clarifier torque switch shall be interlocked to clarifier motor
ii. Alarm shall be triggered upon over torque
d. Alarms
i. High Torque
e. Plant SCADA or auto dialer system
i. Run status
ii. Stop status
iii. High Torque

C. RAS/WAS Pumps.

1. There will be three RAS/WAS pumps. Each pump will have a VFD. The operation of the pumps will be governed by the position of the Hand/Off/Auto selector switch for each pump.

a. In the Hand position, the pump may be started and stopped via the local Start and Stop pushbuttons, unaffected by any pump control/monitor generated interlocks.
    1) The speed of each pump in the Local position will be set manually at the VFD.
    2) The pumps may also be intermittently operated through the use of a timer. The operator will be able to set run time and idle time in order to control the RAS rate below the amount otherwise available with the VFD alone.
b. In the Off position, the pump will not run.
c. In the Auto position, the pump speed will be set though the VFD.

2. The local control panel (or nearby devices) will include the following operational controls and indications:
a. Switches
    1) A Hand/Off/Auto switch to select operational mode for each pump.
b. Pushbuttons:
    1) Start button for each pump.
    2) Stop button for each pump.
c. Digital Displays:
    1) Flows through sludge return line FI-410A.
    2) Pump Speed.
    3) Pump run-time for each pump.
d. Pump Speed Control:
    1) Pump speed can be controlled in Hand (remotely) at the VFD interface.
e. Indicating Lights:
    1) For each of the pumps: Hand, Off and Auto, and Off lights.
    2) Pump alarm (each pump).

3. Devices Associated with Pump Protection:
a. Temperature (RTD) Sensors in Stator Winding (3).
b. Temperature (RTD) on the Pump Main Bearing (1).
c. Leak detection in the pumps.
d. Current in Three Phase of the Pump Motor (through VFD).

4. Interlocks:
a. Each pump shall be interlocked though its monitoring system to its Variable Frequency Drive.
    1) If any of the monitored points are determined by the pump monitoring system as a reason to disable a pump, the pump will not operate.
        a. The pump alarm light on the local control panel shall be illuminated.
        b. A pump alarm status shall be displayed at the pump control panel.

5. Alarms
a. Pump Alarm (each pump, leak, bearing, motor temp)
b. Pump failure to start shall be alarmed locally and in the plant SCADA system.
c. All pump alarms, speed and timer settings shall be available for monitoring though the SCADA HMI or through the plant auto dialer.

6. Failure of the plant SCADA system, or local PLCs shall not prevent the pumps from being operated manually. Pump speeds will be manually set/adjusted at the pumps VFDs.

7. <u>Sludge Wasting.</u>
a. The operation of sludge wasting valve KV-414 shall be governed by the position of the timer KIC-414. The wasting rate can be observed by observing the sludge flow on the display of FIT-410B.
b. local control panel (or nearby devices) will include the following operational controls and indications:

    1) The following devices and calculated values are associated with the sludge wasting system:
        a. WAS flow timer valve KV-414 and timer control KIC 414
        b. WAS Flow meter FE-410B and indicator FIT-410B
    2) WAS valve control:

a. WAS valve position can be controlled while in Local-Hand Mode through the control interface at the valve actuator.

c. Data entry points shall be provided in the plant SCADA HMI or auto dialer for all the monitored points:

a. WAS flow control valve KV-414 status (open/closed)
b. WAS Flow indicator FIT-410B
c. Timer settings

3.4 TERTIARY FILTERS

A. General. The vendor supplied control system will contain the equipment and logic for proper operation of the Filter equipment including all start up, cleaning, shutdown, and safety interlock logic.

B. The plant SCADA HMI or auto dialer shall display all vendor data including, but not limited to, backwash status, filter water level, filter cleaning equipment (rotating assembly) status, and pump status. The systems integrator shall coordinate with the filter system vendor to provide transfer of the data from the vendor furnished PLC based control system to the plant SCADA system.

C. Tertiary Filter System. The tertiary filter operates continuously. Forward flow is passive. Backwash is triggered based on high water level in a filter basin, or on time. A filtration cycle can be triggered manually. An HOA switch is provided at the tertiary filter system control panel. The backwash pumps are single speed. No flow monitoring is provided for backwash rate. The operation of the filter backwash pumps will be governed by the position of the LOCAL/OFF/AUTO selector switch.

1. In the LOCAL position, the filter backwash pumps may be started and stopped via START and STOP pushbuttons on the local station at the pumps.
2. In the OFF position, the filter backwash pumps will not run.
3. In the AUTO position, the backwash pumps operation will be governed by a selector switch for timed operation or basin level operation.
   a. In timed operation the operator may select a timer interval for backwashes.
   b. In level operation, backwash will be initiated when the increased water level in the filter basin (pressure drop across the filters) causes an upper level limit.
4. Pump failure to start shall be alarmed locally and in the plant SCADA system.

D. Local Control panel
1. Indicating Lights
   a. Control panel power
   b. Pump 501 on
   c. Pump 502 on
2. Devices associated with the filters
   a. Local/Off/Auto switch
   b. Timer/Level selector switch
   c. Pump 501 On/Off switch
   d. Pump 502 On/Off switch
   e. Solenoid valve SV-501A
   f. Solenoid valve SV-501B
   g. Solenoid valve SV-501C
   h. Solenoid valve SV-501D
   i. Backwash timer KC-501
   j. Level float LE-501A
   k. Level transmitter LE-501B
   l. Turbidity AE-513
3. Interlocks
   a. Timer/Level Switch
   b. High level alarm
   c. Solenoid valve actuation
   d. Filter cleaning rotation motor
4. Alarms

a. Pump 501 fail to start
b. Pump 502 fail to start
c. Rotation motor 501A fail to start
d. Rotation motor 501B fail to start
e. High level basin 501

5. Plant SCADA system.

a. The plant SCADA system and auto dialer will have the ability to monitor the status of the filter system. Monitoring points shall include all the above devices, alarms and switch positions.

E. Turbidity shall be monitored at the discharge of the filters by AE-513. This is not part of the filter equipment package and must be provided separately but will communicate through the Filter PLC and to the plant SCADA and auto dialer system.

3.5 UV DISINFECTION

A. General. The vendor supplied control system will contain the equipment and logic for proper operation of the UV disinfection equipment including all start up, cleaning, shutdown, and safety interlock logic. In addition, the UV system shall provide the required monitoring and displays as specified in the current State of Texas design rules for ultraviolet disinfection including but not limited to the following:

1. the flow rate in each disinfection channel
2. the relative intensity of the lamps in each bank of a disinfection channel
3. the operational status and condition of each bank
4. the on or off status of each lamp in the system
5. the number of operating hours of the lamps in each bank in the system
6. the total number of hours of operation for each bank in the system
7. the transmissivity of UV light in the disinfection channel

B. The UV system shall have a PLC system that will continuously monitor and display the above information on an HMI panel.

1. Indicating Lights

a. System power
b. Minor alarm condition
c. Major alarm condition

2. Devices Associated with the Ultraviolet Light System

a. System power switch
b. Transmissivity sensors in each UV bank
    1) AE-511C, 512C
c. UV intensity sensor in each UV bank
    1) AIT-511A AIT-512A
d. Effluent flow rate FE-510
e. Lamp hour monitors
f. Lamp failure monitor

3. Interlocks

a. UV intensity shall be based upon the plant effluent flow rate as measured by FE-510 plus the NPW flow rate measured by FE-550.

b. The published peak intensity of a module at 100 hours burn in shall be compared to the measured intensity of the module. An alarm shall notify the operator if the intensity is less than 45% reported for the same number of lamps called to be in operation. A second alarm shall alert the operator if the intensity is less than 25% reported for the same number of lamps called to be in operation.

c. Lamp monitors shall trigger an alarm if 10% of the lamps called to operate fail, or if 10% of the lamps in a module fail, or if 10% of all lamps in the system fail.

d. Loss of flow signal from either the effluent or NPW system shall trigger an alarm.

e. Loss of flow signal from either the effluent or NPW system shall trigger all rows of all modules to energize.
f. Failure of a module shall trigger an alarm
g. Transmissivity less than the design basis shall trigger an alarm.
h. Transmissivity less than the design basis shall trigger all rows of all modules to energize.

4. Alarms

a. The following state mandated alarms will be included as part of the UV System

1) A minor alarm must activate if:
a. the UV intensity of the system is less than 45%, relative to the peak intensity after 100 hour burn in; or
b. there is a lamp outage.
2) A major alarm must activate if:
a. the UV intensity of the system is less than 25%, relative to the peak intensity after 100 hour burn in;
b. more than 10% of the lamps fail;
c. there is a loss of flow signal upon failure of a bank to energize;
d. there is an outage of any module or bank; or
e. the transmissivity is low, based on the manufacturer's recommendations.

C. Plant SCADA System and/or Auto Dialer

1. The plant SCADA HMI shall communicate with the UV system over ethernet TCP/IP and have available all the same information available at the local UV HMI. The systems integrator shall coordinate with the UV system vendor to provide transfer of the data from the vendor furnished PLC based control system to the plant SCADA system or auto dialer.

3.6 EFFLUENT METERING

A. General. The plant effluent flow will be measured utilizing a V-notch weir and an associated ultrasonic level element.

B. Flow shall be totalized in the plant SCADA system and displayed to the operator as the current day's flow total, previous day's flow total and cumulative flow total.

C. Effluent flow alarms as measured by the flow transmitter shall be provided for the following:
1. High Flow.
2. Low Flow.
3. Transmitter Failure.

D. The plant effluent is to be monitored for pH (AIT-512) and DO (AIT-511). Neither pH nor DO will be tied into plant SCADA, the effluent pH and DO will only be a "local" indicator and will not be tied into plant SCADA since effluent pH and DO need only be sampled and recorded on a grab basis.

3.7 PACKAGED LIFT STATION

A. A packaged lift station will be provided to collect and transfer scum from the clarifiers to the sludge holding tank. The lift station will be equipped with two submersible chopper pumps. Each bump shall be equipped with motor winding, motor bearing and leak detection switches. A set of level floats will turn the pumps on and off. Pumps will alternate lead/lag status. Floats will also be provided for low-low level which shall shut off power to the pumps and high-high level which shall alarm and notify the operator of lift station problems. Each pump shall be equipped with run time hour meters, and current indicators.

1. Indicating Lights

a. Pump run status (On/Off)

b. Sump High Liquid Level

2. Devices Associated with the Ultraviolet Light System

a. Pump motor bearing P-421
b. Pump motor bearing P-422
c. Pump motor winding temperature P-421
d. Pump motor winding temperature P-422
e. Pump leak sensor P-421
f. Pump leak sensor P-421
g. Pump hour meter P-421
h. Pump hour meter P-422
i. Motor amps P-421
j. Motor amps P-22
k. Pump alternator
l. Low-Low level float switch
m. Low level float switch
n. High level float switch
o. High-High level float switch
p. Hand/Off/Auto switch
q. Start/Stop push buttons for each pump

3. Alarms

a. High-High level

3.8 NON-POTABLE WATER (NPW) SYSTEM

A. General. The control system will contain the equipment and logic for proper operation of the NPW equipment including all start up, shutdown, and safety interlock logic. NPW pump supplier shall be responsible for providing the all controls in a local stainless or FRP control panel enclosure, suitable for outdoor environment to be located adjacent to pump skid. Control system shall be SCADA ready for future use.

B. NPW Pumps

1. The operation of the NPW pumps, P-601 and P-602 will be governed by the position of the Hand/Off/Auto selector switch for each pump.
   a. In the Hand position, the pumps will run continuously unaffected by any HMI generated interlocks.
   b. In the Off position, the pumps will not run.
   c. In the Auto position, pump operation is controlled by the NPW System supervisory PLC.
      1) Automatic operation bases the operation of the pumps on the pressure of the discharge header.
         a. A decreasing discharge pressure will start the Lead pump at a minimum speed. Operator-entered setpoints for discharge pressure will be used to control the pump speed to maintain the discharge pressure within a range determined by the operator-entered setpoints.

2. The local control panel (or nearby devices) will include the following operational controls and indications:
   a. Switches
      1) A Hand/Off/Auto switch to select operational mode for each pump.
   b. Digital Displays:
      1) Total discharge pressure (on pressure transmitter).
      2) Pump Speed.
      3) Pump run-time for each pump.
   c. Indicating Lights:

1) For each of the three pumps, HAND, OFF, and AUTO lights.
2) Pump alarm (each pump).

d. Devices associated with the NPW System:
1) NPW discharge header pressure (PIT-602)

3. Control points shall be provided for SCADA for the following:
a. Pump Start (each pump)
b. Pump Stop (each pump)
c. Pump Disable (for each pump)

4. Data entry points shall be provided on the plant SCADA HMI for the following:
a. Pump Elapsed Run Time (for each pump).
b. Discharge Pressure Setpoints.
c. Lag Pump Stop Delay Time.
d. Lead Pump Stop Delay Time.
e. Manual mode speed setpoint (for each pump, enabled through VFD).
f. Pump Failure to Start (each pump)

5. Devices Associated with Pump Protection:
a. Current Draw of the Pump Motor (through VFD)

6. Interlocks:
a. Each pump shall be interlocked though its monitoring system to its Variable Frequency Drive.
1) If any of the monitored points are determined by the pump monitoring system as a reason to disable a pump, the pump will not operate.
a. The pump alarm light on the local control panel shall be illuminated.
b. A pump alarm status shall be provided for SCADA system.

7. Alarms
a. Pump Alarm (each pump)
b. Discharge Pressure Alarm

3.9 SWITCHGEAR AND EMERGENCY GENERATOR

A. Main power at the wastewater treatment plant will be fed at 15-kV and stepped down to 480-V before the meter. The generator will generate power at 480-V for distribution. The lift station shall have a separate 480-volt feed. The emergency generator at the lift station shall have its own automatic transfer switch. Both ATS's shall communicate with the plant SCADA system via ethernet or hardwire discrete points for monitoring purposes.. Monitoring shall include:

1. Automatic Transfer Switch
a. Main breaker open status
b. Generator breaker open status
c. Feeder breakers open status
d. Breaker trip statuses
e. Loss of Utility Power
f. Current from Power Meter
g. Voltage from Power Meter
h. VAR from Power Meter

2. 480-V Generators and ATS
a. Generator mode selector switch not in auto
b. Generator mode selector switch in auto.
c. Emergency stop activated.
d. Demand mode standby.
e. Timing for start.
f. Timing for shutdown.
g. Generator circuit breaker closed.
h. Generator circuit breaker open.
i. Remote generator breaker is open.
j. Engine stopped.

k. Time-delay start.
l. Engine running.
m. Engine cool-down.
n. Low coolant temperature.
o. Engine low battery.
p. Battery charger failure.
q. Auxiliary power failure.
r.
s. Overcurrent alarm.
t. Ground-fault alarm.
u. Engine over crank
v. Engine overspeed.
w. Engine low oil pressure.
x. Engine high coolant temperature.
y. Engine low coolant level.
z. Engine remote emergency shutdown.
aa. Generator circuit breaker tripped.
bb. Generator circuit breaker failure
cc. Generator not in auto.
dd. Generator undervoltage.
ee. Generator overvoltage.
ff. Generator underfrequency.
gg. Generator over frequency.
hh. Generator short circuit
ii. Day tank low-fuel shutdown.

END OF SECTION

SECTION 13410

PROCESS AUTOMATION CONTROLLER (PAC)

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of a complete and operational control system consisting of the Eurotherm (Schneider Electric) T2750 Process Automation Controllers (PACs), including hardware and software. The T2750 PAC shall be a hybrid DCS based product and shall be fitted with redundant processors. A redundant Ethernet network shall also be provided.

B. Provision of the T2750 PAC hardware for the locations and requirements shall be identified on the drawings. This shall include all T2750 PAC hardware, software, cables, connectors, T2750 PAC Ethernet cables, termination blocks, network switches, and any other hardware and/or software to ensure a fully operational unit.

C. A new panel featuring the T2750 PACs shall be provided. Note: the existing panel shall be removed, and the new panel installed and wired by an electrical contractor. The wiring of the I/O points shall be checked and tested by the electrical contractor.

1.2 SUBMITTALS

A. Product Data.

1. Submit vendor specification information for each scheduled device specified in this section.
2. Submit vendor specification information for each material and unscheduled device specified in this section.

B. Provide two complete sets of as-built drawings for each T2750 PAC panel. These drawings shall be complete and accurate. Each set of drawings shall be provided in both paper and electronic copy.

1.3 WARRANTY

The manufacturer shall provide an all-inclusive 2-year warranty. The submittal shall provide a contract specific warranty document as detailed in the specifications.

1.4 TRAINING

The manufacturer shall provide operating training and maintenance training as detailed in the specifications.

1.5 SPARE PARTS AND TOOLS

The manufacturer shall provide the specified spare parts and/or tools as detailed in specifications. The manufacturer shall also provide one fully functional shelf spare processor and IO modules for the T2750 PACs, complete with copies of all programming code on flash drives.

The system shall provide a minimum of an additional 10% of the fitted IO and space for an additional 15% future IO for possible expansion.

PART 2 - P R O D U C T S

1.1 GENERAL REQUIREMENTS

A. The T2750 PACs and Eycon 20 HMI shall be supplied by Eurotherm by Schneider Electric.

B. The T2750 PACs shall offer zero-way (no IO), four (4) IO module, eight (8) IO module or sixteen (16) IO module bases.

C. The T2750 PACs shall feature blanking plates in slots where no IO is present.

D. The T2750 PACs shall be capable of collecting discrete inputs via volt free, 24 Vdc or 110 Vac signals.

E. The T2750 PACs shall be capable of collecting analog inputs via 4-20 mA or 0-10 Vdc signals.

F. The T2750 PACs shall capable of providing discrete output signals in the form of logic level outputs (24 Vdc) or by electrically dry relay contacts.

G. Interposing contacts shall be used to interface the T2750 PACs with the field signals.

H. The T2750 PACs shall be capable of providing analog outputs in the form of 4-20 mA or 0-10 Vdc signals.

I. The T2750 PACs shall be capable of providing frequency (pulse) inputs where required.

J. The T2750 PACs shall be configured by LINTools software

K. The T2750 PACs shall be programmed using a comprehensive set of library function blocks.

L. The LINTools software shall be capable of encrypting the system programming to provide intellectual property protection for the client, to add a further level of security to the system configuration, if required.

M. The T2750 PACs shall be capable of onboard loop control, boolean logic, mathematical calculations and sequential operations independent of the Eycon 20 HMI.

N. The T2750 PACs shall feature floating point calculation capabilities.

O. The T2750 PACs shall feature Simple Network Time Protocol (SNTP) for clock synchronization across the network, enabling the T2750 PAC processors to share a common time reference.

P. The T2750 PACs shall be capable of auto tuning PID loops.

Q. Alarms shall be generated at the T2750 and configurable as low, high, deviation and rate of change alarm and shall also be configurable as non-latching or latching alarms.

R. Alarms shall be configurable as delayed alarms and shall be capable of being suppressed under a specific set of conditions.

S. The T2750 PACs shall be connected to the Eycon 20 HMI via ELIN Ethernet network,

T. The T2750 PACs shall be capable of accepting power from dual 24 VDC power supplies to provide power supply redundancy. The dual 24 Vdc power supplies shall be installed in each T2750 PAC panel. The power supplies shall be properly sized, installed, wired, checked and tested.

1.2 T2750 PAC DESIGN REQUIREMENTS

A. Hardware & Software

1. The T2750 PAC processors shall provide ELIN connectivity plus Modbus Ethernet and serial communications capabilities simultaneously.
2. The T2750 PACs shall feature peer to peer communications via ELIN Ethernet protocol.
3. The T2750 PAC processor firmware shall meet the Achilles cybersecurity standard for network resilience.
4. The T2750 PACs shall consist of a DIN rail mounted backplane with two redundant processors.
5. All modules, including the processors shall be hot swappable. This means they can be removed and replaced while under power for ease of maintenance. Removal and replacement of the modules shall be possible without disturbing the field wiring.
6. The T2750 PACs shall feature a real time clock.
7. The analog input modules shall be available in a variety of variants featuring two (2)channel universal inputs (TC, RTD, 4-20 mA & 0-10 Vdc), three (3)channel 4-20 mA inputs featuring loop power supplies for each channel, four (4) channel universal inputs and eight (8) channel 4-20 mA or 0-10 Vdc inputs.
8. The analog inputs shall feature high stability and accuracy and have a minimum of 16-bit resolution.
9. The analog output modules shall be available as two (2) channel 4-20 mA or 0-10 Vdc output and shall feature 12-bit resolution.
10. The discrete input modules shall be available in a variety of variants featuring eight (8) and sixteen (16) channel dry contact input, eight and sixteen channel 24 Vdc logic inputs and six (6) channel 110 Vac inputs and sixteen channel dry contact input and sixteen channel 24 Vdc logic inputs
11. The discrete output modules shall be available in a variety of variants featuring both eight (8) and sixteen (16) channel 24 Vdc logic outputs and four (4) and eight (8) channel relay outputs.
12. The T2750 PACs shall have the ability to be connected to a 4G, LTE or 5G cellular communication system, available in Galveston under the City of Galveston cellular contract with the cellular provider or providers, in order to transmit data back to the Wonderware / T2750 PAC system at the MWWTP.
13. This communication system shall permit two-way (duplex) communication with suitable safeguards in place to prevent unauthorized access and shall have enhanced cybersecurity robustness. The T2750 PAC shall offer Modbus TCP/IP protocol over a cellular Ethernet VPN connection and shall also offer ELIN protocol, if cellular network bandwidth permits its use.
14. The T2750 PACs shall also offer the optional capability of having local data storage added at a future date, should the City of Galveston wish to take advantage of the ability of the T2750 PAC to store data locally. If this option is present the T2750 PAC will store data locally during the cellular network outage. When the cellular network connectivity is restored the data would be sent to the Wonderware Historian at the MWWTP by the cellular network.
15. The T2750 PACs shall have the option to provide secure binary coded check-summed high integrity data files.
16. The T2750 PAC firmware, setup and application program shall be capable of being communicated to the T2750 PAC processors by ELIN Ethernet protocol or by removable compact flash media. The instrument shall also support local on-line reconfiguration capability enabling changes to be made without stopping the running program, if so desired.
17. The programming software shall be LINTools. This software shall be compliant with IEC 61131-3 and support Function Block Diagrams, Sequential Function Charts, Structured Text and Ladder Diagrams.
18. The T2750 PACs shall be capable of operating in an ambient temperature from 0C to 55C (32F to 131F) in a non-condensing environment of 5% to 9% relative humidity.
19. The T2750 PACs shall be configured with both warm start and cold start capabilities. This implies the ability to react to power interruptions in different ways depending upon the duration of the outage. A brief outage, whose duration is to be defined, shall result in a re-start in a warm start manner implying that operation shall continue from where it was in the program, prior to the power outage. In the event of a longer power outage, whose duration is to be defined, operation shall provide a cold start, effectively enacting a reset condition
20. The T2750 PACs shall feature non-volatile memory.
21. The T2750 PACs shall feature a watchdog relay output.

22. The T2750 PAC processors shall have LED's for status, fault detected, battery, communications, IP resolution, watchdog, primary, standby, Ethernet (activity & link), USB (activity & overcurrent).

B. EYCON 20 - HMI

1. The Eycon 20 shall feature a color touchscreen display.
2. The Eycon 20 shall be connected to the T2750 PAC by peer to peer ELIN Ethernet protocol
3. The Eycon 20 HMI shall be programmed using the LINTools software.
4. The Eycon 20 HMI shall feature standard screens and up to 99 custom screens.
5. The Eycon 20 shall feature a Compact Flash (CF) memory card containing the firmware and program, enabling easy replacement with another Eycon 20 HMI by simply unplugging the CF card from the HMI being removed and inserting the CF card into the Eycon 20 HMI being installed.
6. The Eycon 20 shall provide touch sensitive custom keyword capability, enabling the unit to be adapted to the specific application.

C. T2750 PAC – Cellular Connectivity

1. The cellular modem shall be the Cradlepoint IBR-E1700 router / modem or the latest compatible model from Cradlepoint.
2. The cellular modem shall be capable of dual carrier operation should the City Of Galveston decide to implement such a system for enhanced robustness.
3. The Cradlepoint cellular service contract shall be enacted between the City Of Galveston and the service carrier or carriers, and shall be chosen by the City Of Galveston.

1.3 T2750 PAC SOFTWARE REQUIREMENTS

A. The T2750 PACs shall be programmed by a software program referred to as LINTools to provide the specific system functions as described in the specifications. The LINTools software is the software which is used to program the T2750 and Eycon 20 HMI.

1. General Requirements: The following are the requirements for the T2750 PAC programming software package.
    a. Windows ® based.
    b. Be able to program the T2750 and Eycon 20 HMI products.
    c. Be able to monitor T2750 PAC online.
    d. Shall provide Function Block, Structured Text, and Sequential Function Chart program formats.
    e. Have on-line help menus.

B. Diagnostics and System Programming: The T2750 PACs & Eycon 20 HMI shall be programmed to provide the basic system functions as described in the specifications. Specific functions which shall be performed via the LINTools software shall include, but shall not be limited to, the following functions:

1. T2750 PAC network configuration, including IP addressing.
2. T2750 PAC processor loop control, boolean, sequential operations and alarms.
3. Eycon 20 HMI screen configuration, user interface, alarm representation and trend set-up.
4. Analog and discrete IO configuration.

C. Programming Software: Provide two copies of the fully licensed versions of the latest version of the T2750 PAC / HMI programming package, LINTools.

D. The LINTools programming software shall be the full version of package provided by Eurotherm (Schneider Electric). It shall include all the latest service packs provided for the programming package by the manufacturer with discs, manuals, certificates in original packaging. Any licensed software shall be licensed in the name of the City of Galveston.

E. Eurotherm (Schneider Electric) shall make available to the City of Galveston all updates provided by the manufacturer for any provided software during the warranty period.

1.4 PROGRAMMING CABLES

A. Eurotherm (Schneider Electric) shall provide two (2) standard 3 ft long Ethernet cables for LINTools programming to the City of Galveston for the T2750 PAC.

PART 3 - E X E C U T I O N

1.5 TEST REQUIREMENTS

A. Factory Acceptance Test. The T2750 PACs shall be integrated with the other components of the system and tested as part of the system Factory Acceptance Test (FAT) as detailed in the specifications. In addition to the general system test requirements, each T2750 PAC shall be subjected to the tests described in this section with a written confirmation of the test results.

B. T2750 PAC Functional Test. The T2750 PAC system shall successfully pass the functional test detailed in the customer approved test specification. These tests shall include, but shall not be limited to, the tests outlined below. Any combination of these tests can be repeated at the customer's request during the FAT, if applicable:

1. A close and open operation on each control point, showing proper sequence of operations
2. Verify the proper operation of the discrete outputs
3. A test showing that the proper indications are given at an Operator Workstation when one or more status input points change momentarily.
4. A series of communications tests showing all message protocols and formats to which the equipment is designed to respond, and demonstrating that all error-detection or error-correction capabilities function properly, and that the equipment does not respond to erroneous commands
5. A test of selected analog points to verify that the readings are within the specified accuracy when the inputs are at 0, 25, 50, 75 and 100 percent of full-scale
6. A test showing successful communication as a result of established ELIN communications from the Eycon 20 HMI, all requested analog, indication, and alarm points are cached from the T2750 PACs
7. A test verifying that all common equipment, wiring, files, and power supplies are provided for expansion of the T2750 PACs to the ultimate point count specified. This test shall also verify that the power supplies can carry the increased load for this expanded point count.
8. A test to verify the proper operation of the stand-alone capabilities of the T2750 PACs. This shall include configuration of the loops, downloading values from the Eycon 20 HMI and testing the actual control strategy with test signals.

END OF SECTION

SECTION 13412

UNINTERRUPTIBLE POWER SUPPLY

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of complete Uninterruptible Power Supply (UPS) systems, including battery packs for the locations indicated on the drawings.

1.2 REFERENCES

A. ANSI.

B. NEMA.

C. UL.

D. NEC.

1.3 SUBMITTALS

Submit the following information to the Engineer for review:

A. Shop drawings and product data.

B. Installation instructions and wiring detail.

C. Supplier shall certify that the equipment furnished meets or exceeds the VA capacity requirements of this section.

D. Provide battery rack dimensions; battery type, size, dimensions and weight; detailed equipment outlines, weights and dimensions; single-line diagram indicating metering, control and external wiring requirements if required to meet the specified runtime.

1.4 WARRANTY

The manufacturer shall provide an all-inclusive two (2)-year warranty. The submittal shall provide a contract specific warranty document as detailed in the specifications.

1.5 TRAINING

The manufacturer shall provide operating training and maintenance training as detailed in the specifications.

1.6 SPARE PARTS AND TOOLS

The manufacturer shall provide the specified spare parts and/or tools as detailed in the specifications.

PART 2 - P R O D U C T S

2.1 SYSTEM RATING

A. The equipment shall be sized to maintain a system continuous rating for all connected equipment.

B. The UPS system shall be equipped with a battery. The battery shall be capable of supporting the load at rated voltage for a minimum protected period of 20 minutes.

2.2 ELECTRICAL CHARACTERISTICS

A. The system shall be designed for an input of 120VAC, single-phase, two-wire, at 60 hertz, with a 5% total harmonic distortion.

B. The system battery shall be capable of operating a full load.

C. The system shall be designed to deliver output voltage at 120VAC, single-phase, two-wire, 60 hertz, with output voltage regulation of plus or minus 3 percent when on inverter.

D. The overall system efficiency shall be 90% while line power is present.

E. The UPS shall be of a double-conversion (on-line) configuration with a hot-swappable battery replacement capability.

F. The UPS shall be tested in accordance with and comply with the surge voltage withstand capabilities defined in ANSI/IEEE C62.41 Category A & B, 6KV/200 & 500 Amp. 100kHZ ringwave.

G. The UPS output wave on battery voltage shall be a sine wave.

2.3 BATTERY

A. Batteries shall be sealed, maintenance-free lead acid with a 3-6 year typical lifetime.

B. Batteries should be located in thermally isolated compartments or in separate battery modules to minimize battery degradation from heat generated by the UPS.

C. Battery replacement design shall allow for hot-swap change-out of the battery packs without the necessity of turning off the UPS.

2.4 DESIGN AND CONSTRUCTION

A. The UPS shall be housed in a freestanding cabinet unless otherwise specified. Rack mount units may be specified in some applications.

B. Forced air cooling shall be provided to ensure all components are operated within their environmental rating.

C. Rectifier/charger capacity shall be sufficient to supply full load to inverter while recharging fully discharged battery to 60 percent of full capacity in four hours or less.

D. The UPS shall have a front panel display that is capable of displaying the percentage of UPS capacity in use, the percentage of battery runtime available during an AC line power failure and displaying various status codes.

E. The UPS shall be provided with a software package capable of providing various real-time status and diagnostic functions.

F. The UPS shall be provided with dry-contact alarm contacts that indicates the status of the incoming power, and the health of the UPS. These contacts shall be connected to the local PLC for monitoring by the SCADA system.

G. Mean time between failures of 60,000 hours, minimum.

H. The audible noise level shall not exceed 60 db at 1 meter.

I. Electroplate brackets and securing hardware with corrosion resistant material. Secure bolts, studs and nuts with lockwashers.

J. Provide cabinet grounding lug.

K. Cabinet Finish. Primed and painted inside and outside with suitable semi-gloss enamel.

2.5 MANUFACTURER

Approved UPS manufacturers are:

A. Sola HD (www.solahd.com)

B. Powerware (www.powerware.com)

C. Liebert (www.liebert.com)

D. M G E (www.mgeups.com)

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install UPS where shown on the drawings and in accordance with manufacturer's instructions. Connect the alarm contacts to the digital inputs to alarm loss of power to the UPS, and failure of the UPS.

B. Perform field inspection and testing; verify performance criteria; measure battery discharge and recharge times; simulate fault in each system component and utility power.

END OF SECTION

SECTION 13413

CONTROL PANELS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of control panels as shown on the drawings, complete with power supplies, communications equipment, Eurotherm (Schneider Electric) Process Automation Controller T2750 PAC, motor starters, variable frequency drives, pre-wired termination blocks, incoming power surge suppression, UPS, and miscellaneous equipment to provide a fully functional system as shown on the drawings and specified herein.

B. This section also specifies the requirements for the provision of connection wiring within panel and electrical accessories such as switches, pilot lights, relays, terminal blocks, and fuses, which are included in the panel.

C. All work and products shall conform to the designs shown on the applicable drawings, and shall comply with the provisions of this section. All control panels shall be factory-wired. Panels and cabinets shall include all components indicated in the applicable drawings, required to provide functions as specified in this section. Where specific requirements on the drawings conflict with general design requirements in this section, the requirements shown on the drawings shall prevail.

1.2 REQUIRED PANELS

Panels shall conform to the requirements indicated on the drawings and specified herein and sized to accommodate the initial and future Input / Output (I/O) point counts. The panels shall be supplied by Eurotherm (Schneider Electric).

1.3 QUALITY ASSURANCE

All equipment and accessories provided shall be the product of a manufacturer regularly engaged in manufacturing of this equipment whose products have been in satisfactory service for not less than 3 years. Completed panels shall bear the UL label.

1.4 PANEL COMPONENT LAYOUT

Follow the arrangements of components shown on the drawings. Adjust as necessary to allow each component to be mounted as recommended by the manufacturer, to facilitate easy installation, removal and in-place maintenance of each component, and to allow normal operation of the component by operating and maintenance personnel. Component arrangements shall allow space for routing of wiring without kinking or bending around sharp edges, and for free flow of air around and through equipment, which requires ventilation for cooling.

1.5 WARRANTY

Provide an all-inclusive 2-year warranty for labor and materials.

1.6 TRAINING

The manufacturer shall provide operating training and maintenance training as detailed in the specifications.

1.7 REFERENCE STANDARDS

A. All materials and workmanship shall conform to the latest published applicable provisions of the following codes and standards:

Standards	**Title**
ANSI/NFPA 70	National Electrical Code (NEC)
ANSI/NEMA ICS 1	General Standards for Industrial Controls and Systems
ANSI/NEMA ICS 2	Industrial Control Devices, Controllers, and Assemblies
ANSI/NEMA ICS 3	Industrial Systems
ANSI/NEMA ICS 4	Terminal Blocks for Industrial Control Equipment and Systems
ANSI/NEMA ICS 6	Enclosures for Industrial Controls and Systems
ANSI/NEMA 250	Enclosures for Electrical Equipment (1000 Volts maximum)
EIA RS-310-C	Racks, Panels, and Associated Equipment
ANSI-C-37.13	Low-Voltage AC Power Circuit Breaker (600 Volt Insulation Class)
ANSI/IEEE-C-37.90-1	Standard for Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
ANSI/IEEE C39.5	Electrical Isolation for Analog Signal Devices
UL 508	Industrial Control Equipment
UL 508A	Industrial Control Panels

B. Unless otherwise specified, electrical equipment and material provided under this contract shall be listed and labeled for the purpose for which it is used by the Underwriters Laboratories, Inc. (UL). This requirement may be waived only if a UL listing is not available for the type of product and approved by the Engineer.

1.8 SUBMITTALS

A. General. Submit for all items supplied. For each panel, submit a certified factory (shop) test report prior to shipment of panels.

B. Product Data. Provide product data sheets for each item utilized.

C. Elementary Control Diagrams. Provide elementary control diagrams, using the ladder diagram format incorporating line number, operation function statement, contact location line number with an underline for a normally closed contact and a description of operation of each device. Label each contact, coil, and indicator with its function, as well as its number. Show terminals for field wiring. Show field wiring as dashed lines.

D. Panel Layout Drawings. Show the general arrangement of the equipment within the control panel. The view shall be from the front of the panel with an open door. Include any section views necessary to present a clear picture of equipment mountings and clearances.

E. Connection Diagrams. Provide connection diagrams which show the following:

1. Placement, labeling and wiring of components within panels and cabinets.
2. Components arranged in the physical layout (not necessarily to scale) as it would appear to a person servicing the equipment.
3. Wires as a continuous line between their termination points.
4. The direction of entry to a wire bundle.
5. Wire lists and wire less diagrams are not acceptable.
6. Additions and deletions of devices and wires in existing enclosures.
7. Each wire label designation.
8. Identical wire label designations on each end of a single wire.
9. Wire termination point numbers.
10. Each wire color.
11. Signal and DC circuit polarities.
12. Jumper, shielding and grounding details.
13. Wire pairs.
14. Spare wires and termination points.

F. Test Procedures. Submit Factory Acceptance procedures as required in the specifications.

G. Submit thermal calculations for all panels.

PART 2 - P R O D U C T S

2.1 CONTROL PANELS

A. Physical and Miscellaneous Specifications. The enclosures shall:

1. Non-conditioned Spaces. NEMA 4X 316 stainless steel with 3-point latching handle.
2. Conditioned Spaces and all LCPs provided by the Systems Integrator. NEMA 12 painted steel with 3-point latching handle.
3. Contain Eurotherm (Schneider Electric) T2750 PAC control equipment, surge arresters, circuit breakers, fuses, relays, transformers, terminal strips, nameplates, terminal labels, wire ducts, universal spiral wraps and any necessary parts for a complete systems as shown on the drawings and specified herein.
4. Be wall mount or free standing as appropriate for the application.
5. Allow expansion space to accommodate future system needs.

2.2 PANEL FABRICATION

A. Materials. The enclosure shall be made with 14 gauge, minimum for wall-mounted units and 12 gauge, minimum for floor- or free-standing units. Each shall be provided with a full length interior panel(s) with adjustable mounting on both vertical sides to rails located at the top, bottom, and middle of the enclosure.

B. Acceptable Manufacturers.

1. Hoffman Engineering Company (www.hoffmanonline.com).
2. Rittal (www.rittal.com).
3. The EMF Company (https://www.emfcompany.com)
4. Approved substitution.

C. Dimensions. Panels shall be sized to accommodate all initial and 25% spare space.

D. Face-Mounted Instrument Reinforcement. Face-mounted devices shall be mounted to panel doors using mounting methods recommended by the component manufacturer with mounting kit parts provided by the

component manufacturer specifically for the component. If such a mounting method causes the door to deform or allows the component to sag so as not to be perpendicular to the door surface, then design and install appropriate reinforcement to prevent these conditions. Addition of the face-mounted devices shall not compromise the rating of the enclosure.

E. Miscellaneous.

1. Face-mounted equipment shall be flush or semi-flush, with flat black escutcheons. Cutouts for future equipment and holes resulted from removal of existing devices shall be blanked off with suitable covers as required to retain the cabinet's NEMA rating. Component identification shall be hot ink stamped on the panel interior.
2. All miscellaneous hardware and fittings shall be 316 stainless steel, minimum.

2.3 NAMEPLATES

Machine engraved, three ply laminated phenolic nameplates shall be provided for all panels and cabinets as shown on the drawings. Nameplates shall be black with white lettering. Nameplates shall be attached to the panel with a minimum of two self-tapping 316 stainless steel sheet metal screws. The height of each character shall be a minimum of 3/16 inch, except as noted.

2.4 WIRING AND ELECTRICAL DEVICES

A. General. Provide electrical devices specified below and associated wiring to provide a fully functional control panel system.

B. Power Distribution.

1. Unless otherwise specified, power for instrumentation equipment shall be obtained from a 120VAC, 60 hertz branch circuit panelboard.
2. Each cabinet shall be equipped with a 120VAC main power disconnect circuit breaker and power distribution circuit breakers as shown on the drawings. Circuit breakers shall be sized in accordance with ANSI/NFPA 70 - NEC. Circuit breakers shall be rated at 250VAC with a minimum AIC rating of 10,000 amps. Mount circuit breakers on a standard DIN rail and be channel mounting type.
3. For each power circuit breaker, a neutral return terminal block shall be installed at the bottom of the breaker rail. The neutral return terminal block shall be standard DIN-rail mounted, and shall be rated the same as the phase bus and accept up to two 12 AWG wires. This terminal block shall conform to the requirements specified herein.

C. Panel Connection Wire and Cable.

1. All cable furnished by the contractor, including cable with any and all wires terminated at both ends within the same panel or enclosure and cable with any wires terminated at more than one panel or enclosure, shall conform to the requirements specified below.
    a. Power and Control Cable. Power and control wiring shall be single conductor stranded copper Type MTW. Power wiring from the main circuit breaker to distribution breakers shall be 12 AWG minimum. All other single conductor 120VAC and 24VDC power and common return wiring, common ground buses and all common logic bus circuits shall be 14 AWG minimum. Circuits protected by 20 Amp circuit breakers shall be 12 AWG minimum. All power wiring shall be rated for 600V and 90°C.
    b. Single Conductor Wire. All single conductors used for logic, T2750 PAC input/output and discrete control circuit wiring shall be No. 16 AWG stranded conductor copper, Belden Type 9916 (0.092-inch O.D.), or approved substitution.
    c. Multi-conductor Foil-shield Cable (TP). All multi-conductor cable used for logic, T2750 PAC input/output and discrete control circuit wiring shall be No. 16 AWG stranded copper conductors with polyvinyl/chloride jacket. The cable shall be rated for a minimum of 600 volts and 80°C. The

cable shall have an overall aluminum/polyester foil shield with drain wire, Alpha XTRA-Guard 1, or approved substitution.

d. Analog Signal Cable. Wiring for 4-20 milliampere, 1-5 volt DC signals and other analog signals shall be No. 18 AWG stranded copper twisted pair shielded cable, 80°C rated, UL listed, 0.25 inches maximum outside diameter, with 100 percent coverage aluminum foil mylar-lines shield and No. 22 AWG (minimum) stranded tinned copper drain wire, Houston Wire and Cable, Belden, or approved substitution. Multi-pair analog signal cable shall be individually shielded (with drain wire) No. 18 AWG stranded conductor copper with a 100 percent aluminum/polyester foil shield with drain wire and an outer PVC jacket. The cable is designated TSP on the drawings. The cable shall be rated for 600V, 80°C (NEC Article 300-3).

e. Multi-Individual Conductor (TP). Multi-individual conductor cables used for logic, T2750 PAC input/output and discrete control circuit wiring shall be number 16 AWG stranded copper conductors with polyvinyl/chloride jacket. The cable shall be rated for a minimum of 600V and 80°C. The cable shall be Belden, or approved substitution.

2. Wire Tagging. All panel connection wiring shall be tagged at terminations with machine printed slip on type tags. Show wire/cable tag designations on all wiring diagrams submitted to the Owner. There shall be a tag placed within two inches of any wiring termination. The tag shall be fixed to the wire to prevent the tag from sliding more than two inches from the terminal as the result of gravity and vibration.

3. Control circuit, logic bus and power circuit wires shall be tagged as follows:

a. Control Circuits. Each individual connection wire shall be tagged at both ends of the wire with a wire number. The tag shall be placed on the wire within two inches of the terminal to which the wire is terminated. Assign a unique number for each wire within a panel.

b. Power Circuits. All 120VAC power wires shall be tagged with the designation "120VAC-" followed by the circuit breaker number shown on the drawings, then followed by a letter designating whether the wire carries the line (L), neutral (N) or power ground (PG).

c. Positive 24VDC power circuit and power bus wires shall be tagged with the designation "+24VDC-" followed by the circuit breaker number shown on the drawings, and 24VDC power returns shall be designated with "24VDC COMMON".

4. Wire Colors. Control, logic bus and power conductors in panels shall have the following insulation colors:

Usage	**Color**
Line Power	Black
Neutral	White
Power Ground	Green
+24 VDC Panel Bus	Blue
+24 VDC Field Bus	Orange
24 VDC Common	Gray with Red Stripe
Control	Red
Foreign Voltage (voltage supplied by a source external to the panel)	Yellow

5. Signal Circuits. Signal circuit multi-conductor cables shall be tagged at each end with the designation shown on the wiring diagram. Each signal conductor shall be tagged at each end with the designation of the terminal block to which it is connected. Individual conductors in each pair of twisted-pair cable shall have distinctly different colors, such as black and white, black and clear. Shield ground common wires connected between drain wire terminals shall be green and shall be tagged "SG".

D. Terminal Blocks.

1. Unless otherwise shown or specified, terminal blocks shall be captive screw with pressure plate, DIN EN 50035 rail 600Vt rating. Terminal blocks shall be the type specified in the following table, or approved substitution:

Description	**Type**	**Application**
Terminal Block	Phoenix UK 5 N	120 VAC, Neutral
Grounding Terminal	Phoenix USLKG 5	Equipment Grounding Block
End Clamps	Phoenix E/NS 35 N	Each Group of Blocks
Terminal Marking	Phoenix ZB 6	All terminal Blocks as required

Terminal Strip Marker	Phoenix KLM-A	Each Group of Blocks
Insertion Strip	Phoenix ESL	As Required

2. Provide Phoenix Contact UK6.3 fused disconnects with light indicators for 24VDC and 120VAC circuits with fuses as shown on the drawings (www.phoenixcon.com). Provide 20 fuses of each type as spares.
3. All T2750 PAC I/O points shall be terminated at terminal blocks within the respective enclosure. Terminating field wiring directly to I/O modules is not permitted.

E. Terminal Tags, Covers and Markers. Each terminal strip shall have a unique identifying alphanumeric code designation at one end and a plastic marking strip running the entire length with a unique number for each terminal. Assign terminal strip numbers from the number "1" and continuing in ascending cardinal order. The terminal strip designation shall be the letters "TB" followed by the terminal strip number. The strip and terminal point designations shall be machine printed and l/8" high. Terminal blocks carrying 120VAC power circuits shall be provided with a transparent, hinged cover for personnel protection and accessibility.

F. Wire Routing. Wires shall be routed in slotted plastic wire-ways with snap covers. Wires carrying 120VAC shall be separated from other wires and signal cables, and shall be routed only in ducts shown on the drawings to be for 120 VAC. If the power wiring has to cross the signal wiring, the crossing shall be as close to a right angle. Ducts shown for 24VDC shall be used for all other wires and cables. Wires and cable shall be routed along the shortest route between termination points, excepting routes which would result in routing 120VAC and other wires and cables in the same duct. For intrinsically safe signal wiring refer to ANSI/ISA RP12.6 "Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations." Wires and cables shall have sufficient length to allow slack and to avoid any strain or tension in the wire or cable. Wires and cables shall be placed in the ducts in a straight, neat and organized fashion and shall not be kinked, tangled or twisted together.

G. Wire Terminations.

1. Single wire and cable conductors shall be terminated according to the requirements of the terminal device.
2. For captive screw, pressure plate and screw terminals, appropriately sized lugs shall be used. Lugs shall be crimp on type that form a tight connections. All crimping shall be done using a calibrated crimping tool made specifically for the lug type and size being crimped.
3. On shielded cables, the drain wire shall be covered with insulating tubing along its full bare length between the cable jacket and the terminal lug or terminal pressure plate.

H. Single Position Indicating Lights.

1. Single position indicating lights shall be push-to-test LED, 24VDC, NEMA 13, heavy-duty, oil-tight, nominal 1.5 inch diameter. The lens color shall be as designated on drawings.
2. Single position indicating lights shall be Allen Bradley, Square D, or approved substitution.

I. Electro-Mechanical Relays. Control relays shall be UL or CSA approved, and provided with two Form C silver contacts rated at 3 amperes at 28 VDC, and shall be hermetically sealed. Where the drawings show a requirement for more than two contacts for a single control relay, two relays shall be provided with the coils wired in parallel. Coils shall be 24VDC. Relays shall be mounted on sockets with retainers, and shall be wired with drop out voltage spike suppression diodes in parallel with all coils, with the cathode of the diode connected to the positive side of the coil. Electro-mechanical Control Relays shall be IDEC (www.idec.com) type RY2S-LD with indicator light, Potter and Brumfield (www.tycoelectronics.com), or approved substitution.

J. Solid Sate Relays.

1. Phoenix Contact, PLC-RSC or approved equal.

K. Cabinet Lighting. Each panel shall be provided with an internal LED lighting. Lights shall operate from 120VAC, and shall be wired to power through a door-mounted switch, which shall be activated by opening the cabinet door, to be located and wired as shown.

L. Circulation Fan. Provide a 120-volt circulation fan with mounting bracket in each panel. Fan shall be 4" capable of 100-cfm.

M. Power Line Surge Protectors. Each panel shall be provided with a 120VAC, 20 Ampere service power line surge protector. The surge protectors shall be heavy duty, multi-stage, and high speed. Response time shall be 5 nanoseconds maximum, and shall allow 340 Volts maximum peak surges to pass through. Protector shall be wired to the cabinet ground bar via a dedicated #8 AWG solid copper wire. The power line surge protectors shall be EDCO Type HSP-121 (www.edcosurge.com), or approved substitution.

N. T2750 PAC I/O Wiring Requirement. All T2750 PAC I/O logic circuit wiring inside the T2750 PAC panel shall conform to the requirements specified below:

1. Discrete Input Wiring Requirement. Each spare discrete input shall be hardwired to an individually fused input before hardwiring to the terminal.
2. Discrete Output Wiring Requirement.
   a. No matter what type of T2750 PAC discrete output will be used in the systems, "dry" contact or logic (24 Vdc) output, every discrete output shall have an interposing relay for an isolation of T2750 PAC I/O board from the field side. The interposing relay shall be rated 24VDC coil and 2 amp contact for 120VAC or 24VDC. If a logic (24 Vdc) discrete output board is selected and used for DC circuit, a drop out voltage spike suppression protection circuit shall be paralleled in each coil circuit. Provide a fuse per common group.
   b. Each spare T2750 PAC output or output relay shall be hardwired to the terminal block.

O. Analog Input and Output Wiring Requirement. Each analog I/O shall have a voltage surge arrester in circuit to protect analog input from the any electronic surge damage. Dehn (www.dehn-usa.com) DIN mounted overvoltage arrester Blitzductor or DEHNconnect series shall be used in each analog circuit, including all spare I/O. Provide a fuse for each analog signal.

P. Panel Ground.

1. Each panel shall be provided with a 1 inch high x 0.25 inch thick solid copper grounding bus bar across the bottom of the panel. The grounding bar shall be mounted on insulated standoffs so that no electrical connection is made between the grounding bar and the cabinet through the mounting. The ground bar shall be drilled and tapped for a .25-20 screws at 0.5 inch intervals along its entire length.
2. An uninsulated solid copper #8 AWG ground wire shall be attached between the ground bar and the panel enclosure, and between the ground bar and the mounting panel.

Q. Power Supply. Each panel shall be provided with 24 Vdc switching type power supplies connected in parallel via current steering diodes. These power supplies shall operate from 120VAC input power and shall provide direct current output current of its rating amperage at up to 60°C. The input voltage range shall be from 85 to 230 Vac. Output load shall be accuracy 24.5 V dc ± 1%. Ripple shall be less than 100 mV p-p. The power supplies shall have integral output current limiting and over voltage protection. The power supplies shall have fully enclosing cases. The power supply shall be manufactured by Eurotherm, TDK Lambda, or approved substitution.

R. Uninterruptable Power Supply. The panel shall be equipped with an Uninterruptable Power Supply (UPS) to maintain the supply to the 24 Vdc power supplies for a period to be defined. This shall enable the T2750 PAC, Eycon and cellular modem to function during a power outage. During this time the cellular modem shall be able to report the power outage to the main WWTP Wonderware system in order to log the occurrence and to alert MWWTP personnel as to the status of the Pirates Beach facility. The UPS shall be manufactured by APC, or approved substitution.

S. Condensation Heater. Provide thermostatically operated condensation space heaters, which are sealed and safe to touch.

T. Wiring Duct. Plastic wiring duct shall be slotted type with dust cover, Panduit type E or NE, as required.

PART 3 - E X E C U T I O N

3.1 TEST REQUIREMENTS

Shop (Internal) test the panels and correct any defects discovered prior to delivery. These tests shall consist of the following:

A. Verify that each wiring connection is made properly by checking electrical continuity, ensuring that connections have less than one Ohm resistance end to end, and that no cross continuity exists between separate circuits.

B. Conduct a test of all power circuits and power supply equipment to verify that proper voltages are delivered and all power supply equipment is operating according to the manufacturer's specifications. These tests shall be witnessed by an approved representative. Document the results in writing and include in Factory Acceptance Test documentation.

C. Functionally test each electrical device to verify correct operation. Test each input/output point. Inputs shall be exercised at the location in the panel the greatest distance in the circuit from the T2750 PAC chassis and verified through to the T2750 PAC processor. Results shall be demonstrated on a programming terminal. Each output shall be exercised from a programming terminal and verified through to the panel location the greatest distance in the circuit from the T2750 PAC chassis. Analog inputs and outputs shall be tested at 0%, 25%, 50%, 75%, and 100% of range. This test shall be witnessed by an approved representative and document the results in writing and include in Factory Acceptance Test documentation. Test the operator interface unit, including simulated alarm conditions.

D. Test Ground Fault Interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.

E. Factory Acceptance Test (FAT).

1. The FAT and verification for all equipment, software, and associated documentation shall be performed prior to system, subsystem, or major components shipment. The tests shall be performed to verify that the equipment is manufactured and assembled correctly, is operating as designed, and confirms to the contractual documents. The tests shall be performed to verify also that the software and hardware will meet the functional and performance requirements of the contract documents. The City of Galveston Owner and the Engineer will witness these factory tests. The supplier of the control system shall provide the following for the City Of Galveston and the Engineer.
    a. Notification 4 weeks in advance of the tests.
2. The FAT shall demonstrate compliance to the stated requirement in the specification. Use the approved FAT plan submitted under Article 1.6 of this specification.
3. The FAT shall include the following:
    a. Equipment Test and Verification. The FAT for the equipment (hardware) test and verification shall include individual end-item verification and integrated tests of all hardware. These tests shall include visual inspection verification and running the standard hardware diagnostic programs, plus all special diagnostic programs used by the Contractor to demonstrate that the hardware integration task has been completed.
    b. System Functional Test. The FAT for the system functional test shall exercise every specified system function and shall include, but not be limited to, the following:
        1) Rigorous exercising of all devices both individually and collectively.

2) Verification of proper update and data acquisition of status and data points.
3) Demonstration of all redundant functions and components.
4) Demonstration of all required data base management functionality.
5) Demonstration of all required software support utilities.
6) Demonstration of all system diagnostics, both on-line and off-line.

c. Project Application Software Tests. The FAT for the project application software shall demonstrate to the best extent possible, the proper functioning of the application control logic implementing the control strategies for this project. These tests shall include:

1) Control logic response to both field inputs, operator changes, and any interlocks.
2) System event and alarming.
3) Trending of variables.
4) System reporting.
5) System redundancy.

d. Support Software Tests. The FAT for the support software shall include the following, as a minimum:

1) Demonstration of system editing capabilities including the addition and deletion of points in the T2750 PAC; the addition, deletion, and modification of HMI displays; the addition, deletion and modification of report formats; the addition, deletion, and modification of control strategies; and the modification of the database and all database parameters.
2) Demonstration of the editing of all system parameters including timers, intervals, etc.
3) Demonstration of utility software facilities, including assembling, compiling, appending, downloading and uploading of programs. On-line programming and debug facilities shall also be demonstrated.

3.2 PANEL INSTALLATION

A. Shop Testing. Coordinate panel delivery with the construction of the control room and panel locations to minimize field handling.

END OF SECTION

SECTION 13420

INSTRUMENT COMMISSIONING

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of instrument commissioning, including but limited to inspection, operational testing, adjustment and calibration of each device, subsystem and system and placement of each device and system into service.

1.2 SUBMITTALS

A. Test Plan.

1. At least 60 days before commissioning starts, submit a description of the tests to be conducted.
2. Include list of test equipment, test procedures, check- lists and test report formats.
3. At the completion of each commissioning phase, deliver all test reports for that phase to Engineer with statement that phase test requirements have been satisfied.
4. Make shop drawing distribution.

B. Responsibility. Review for acceptance by the Engineer of any plan, report or other commissioning activity will not relieve the contractor of his responsibility to meet the contract requirements.

C. Description. Provide field instrumentation accessories to complete installation of sensors, meters, switches, transmitters and similar devices. Each installation includes:

1. Device.
2. Mounting stand where required.
3. Process leads, connectors, valves, support means and all other devices and material required for a complete installation.

1.3 QUALITY ASSURANCE

A. Referenced Standards.

1. ANSI C37-90a.
2. API RP550.
3. ASTM 153.
4. ASTM B 62.

B. Factory Testing.

1. Subject each device to a complete functional test.
2. Wet flow calibrate flow meters to within specified accuracy.
3. Submit a certified calibration report for each meter showing results of calibration at a minimum of five points evenly spaced throughout range.
4. Apply a Surge Withstand Capability test wave:
    a. As defined in Section 2 of ANSI C37.90a-1974, to each power supply circuit, battery circuit, signal circuit, output circuit and input circuit.
    b. Application of test wave shall be as described in Section 4 of ANSI C37.90a-1974.
    c. Submit a certified copy of test showing the no load test waveform, details of test wave generator circuit and description of test conducted.

1.4 SUBMITTALS

A. Product Data.

1. Submit vendor specification information along with a corrected copy of applicable specification form for each scheduled device specified in this section.
2. Submit vendor specification information for each material and unscheduled device specified in this section.

PART 2 - P R O D U C T S

2.1 MATERIALS

A. Devices and systems are specified in other sections of this specification. Reference to "devices" means all devices included in the contract.

B. Any device that fails to meet contract requirements or published performance specifications of the manufacturer must be repaired or replaced as directed by the Engineer at no cost to Owner.

C. Demonstrate that test equipment is fully operational and properly calibrated.

D. The Engineer reserves the right to disapprove test equipment that is improper or functioning improperly.

PART 3 - E X E C U T I O N

3.1 OBSERVATION

A. The Engineer reserves the right to witness any test, inspection, calibration, or start-up activity.

B. Notify the Engineer in writing at least 24 hours in advance of any test. All tests executed without notifying the Engineer are invalid and must be repeated.

C. Perform commissioning of each device, subsystem and system under direct supervision of the individual manufacturer's factory-trained representative.

3.2 REPORTS

A. Prepare report showing test procedures, conditions and results of each test. In the test report, give applicable contract requirements, manufacturer's performance specifications, and permissible tolerances at each test point, actual values of test signals and actual values of test results. Provide report bound in a three ring binder.

B. Check-off List.

1. Maintain a check-off list by loop number indicating tasks remaining to be done to make loop operational.
2. Submit check-off list form at least 60 days before commissioning starts.
3. Submit check-off lists when requested by Engineer.
4. Lists will be requested no more frequently than once a week.

3.3 SCHEDULING GUIDELINES FOR COMMISSIONING PHASES

A. Perform all commissioning in accordance with the instructions on the Contract drawings, these specifications, manufacturer's instruction manuals and the direction of the Engineer.

B. Commission field devices, after installation of field instruments and prior to commissioning the instrument or the control panel.

C. After installation of the instrument or control panel and prior to loop commissioning, commission panel-mounted devices and systems.

D. After commissioning field devices and panel-mounted devices, commission loops.

3.4 REQUIREMENTS

A. Transmitters and Receivers.

1. Remove shipping stops before starting with these procedures.
2. Have manufacturer's instruction manuals available.
3. Install miscellaneous components such as charts, illumination, etc., which have been supplied separately but are integral parts of equipment.
4. Test and exercise each instrument to demonstrate correct operation, first individually, then collectively as a functional network.
5. Check calibration of and recalibrate, where necessary, instruments at a minimum of four points over full operational range and prove instruments to be within specified accuracy.
6. Calibrate instruments individually and, where applicable, as loop (i.e., transmitter, controller and valve).
7. Specified accuracy for loop is defined as root-mean- square-summation (RMS) of individual device specified accuracies.
8. Individual device specified accuracy requirements shall be as specified by contract requirements or by published manufacturer accuracy specifications whenever contract accuracy requirements are not specified.
9. Test each loop by applying simulated analog and/or discrete inputs to first elements of loop (i.e., applying simulated analog and/or discrete sensor signals) and measuring outputs from final elements of loop, (i.e., controllers, alarms, indicators, etc.).
10. Apply continuously variable analog inputs to verify proper operation and setting of discrete devices (i.e., alarms, etc.).
11. Make provisional settings on controllers, alarms, etc., during loop installation tests.
12. Prepare calibration report on each instrument and loop.

B. Integrators, Ratio Relay, etc.

1. Check devices in conformance with manufacturer's recommendations.
2. Receiver integrators may be calibrated for proper operation and multiplication factor by feeding maximum input signal for a specified period of time using a stopwatch.
3. Ratio signals may be simulated to check proper ratio settings and output.

C. Flow Meters and Level Transmitters.

1. Perform volumetric draw down of fill test for all liquid flow meters and level transmitters.
2. Prepare test report for each meter and level transmitter.
3. If test results conflict with calibration report, recalibrate in accordance with subparagraph A above, and repeat volumetric draw down or fill test.
4. Continue until draw down test results prove calibration to be correct.

D. Level Switches. Perform draw down test for each level switch. Set switch in accordance with specifications or in absence of switch setting in specifications, set in accordance with instructions from Engineer.

E. Controllers.

1. Check control action of each controller.
2. Check calibration of gain, integral and rate adjustments where specified including all modes of operation.
3. For each setting, check output for at least three inputs evenly spaced through input range.
4. Check at least three settings for each adjustment evenly spaced throughout the adjustment range.
5. Run all diagnostic procedures.

F. Interlocks. Ring and check interlocking circuits for conformance to plans and specifications.

G. Start-up of Instruments.

1. Test each control loop under start-up and steady-state operating conditions to verify that proper and stable control is achieved using instruments in each instrument panel and control panel.
    a. Test control of final control elements using specified modes of manual and automatic control.
    b. Demonstrate bumpless transition between control station modes.
    c. Use signals from transducers, sensors and transmitters.
    d. Simulated input data signals may be used subject to prior written approval by the Engineer.
2. Set proportional band, reset rate and derivative settings for each controller as recommended by manufacturer.
3. Verify transient stability of each control loop by applying control signal disturbances, monitoring amplitude and decay rate of control parameter oscillations and making necessary controller adjustments to eliminate excessive oscillatory amplitudes and decay rates while retaining control sensitivity. Verify proper suppression of "reset wind-up."

H. Component Calibration Sheet.

1. Calibrate and ring out all devices that are to be interfaced with the distributed control system, including devices purchased and installed under other contracts.
2. Each active instrument element (except simple hand switches, lights, etc.) and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for signoff by the contractor.
    a. Project name.
    b. Loop name.
    c. Component tag number or I/O module number.
    d. Component code number.
    e. Manufacturer.
    f. Module number/serial number.
    g. Summary of function requirements.
    h. For indicators and recorders. scale and chart ranges.
    i. For transmitters/converters. input and output ranges.
    j. For computing elements.
    k. I/O modules. required and actual inputs or outputs of 0, 10, 50, and 100 percent of span, rising and falling.
    l. Space for comments.
    m. Space for signoff by Contractor.
3. Maintain the Loop Status Reports and Component Calibration Sheets at the job site and make them available to the Engineer at any time.

END OF SECTION

SECTION 13421

INSTRUMENTS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of field instrumentation, including but not limited to analytical, flow, level, and pressure instruments.

1.2 QUALITY ASSURANCE

A. All instruments shall be of the quality as specified.

B. All instruments are to be factory-tested to assure proper function and operation. The Contractor shall supply test results and calibration records.

C. Contractor shall be responsible for instrument installations and configurations.

1.3 SUBMITTALS

Provide submittals in accordance with the specifications.

1.4 JOB CONDITIONS

A. Environmental Requirements. The equipment shall operate in ambient temperature 0-130°F, relative humidity 0-100%.

B. Project Power. 120VAC, 60 hertz single-phase. Contractor shall provide appropriate isolation and protection. Two-wire type transmitters shall be capable of operation from a 24VDC supply.

C. Standard Signal.

1. Output Signal. Each instrument, which outputs a signal, shall output the standard 4-20 mA signal. The signal shall be constant over a load range of 0 to 600 ohms.
2. Input Signal.
   a. Electronic devices, such as controllers, match function devices etc., shall have an input impedance of one Mohm minimum for an input signal of 1 to 5VDC.
   b. The 1 to 5VDC signal shall be developed by the standard 4 to 20 mA transmitted signal through a precision 250 ohm, one-watt resistor.
   c. These requirements allow several receiving units to monitor the same transmitting unit without causing any perturbation of the received signal.
   d. Receiving devices shall not be wired in parallel.

PART 2 - P R O D U C T S

2.1 ANALYTICAL EQUIPMENT

A. pH Sensors.

1. Hach DPD1R1
2. Supply with immersion-mounting hardware for each sensor.
3. To be used in conjunction with 2-sensor Hach sc200 or sc1000 controller.

B. ORP Probes.

1. Hach Digital PC sc and RC sc 3/4 Inch Combination pH/ORP Sensor, Convertible Style, Ryton Body Material, Flat Glass General Purpose pH Electrode, Temperature Compensation - PT1000 ohm RTD, 15 ft cable.
2. Supply with immersion-mounting hardware.
3. To be used in conjunction with 2-sensor Hach sc200 or sc1000 controller.

C. Ammonium & Nitrate Probes.

1. Hach AN-ISE sc Combination Sensor for Ammonium and Nitrate.
2. Supply with immersion-mounting hardware.
3. Supply with High Output Airblast Cleaning System and cleaning unit.
4. To be used in conjunction with 2-sensor Hach sc200 or sc1000 controller.

D. DO Probes.

1. Luminescent-type Hach LDO sc Model 2
2. Supply with immersion-mounting hardware for each sensor.
3. To be used in conjunction with 2-sensor Hach sc200 or sc1000 controller.

E. Humidity/Temperature

1. Dwyer series WHT 311Weather-Resistant Humidity/Temperature Transmitter
2. 4-20 MA output for both temperature and humidity
3. Mount under canopy

F. Turbidity NTU – Flow Trough Type for Filtrate

1. Sensor: Hach Solitax t-line sc Turbity Immersion Probe with Wiper, PVC
2. Transmitter/Controller: Hach SC200
3. Include sun shield for Hach SC200 and mounting pole for sensor to allow probe to be positioned in the horizontal position when immersed.

G. Turbidity/TSS - Insertion Type.

1. Four beam pulsed light method for compensation of sensor soiling and wearing of optical components
2. Turbidimeter: Quadbeam Technologies S10-SWW (0-25 g/L for Clarifier underflow) S20-SWW (0-10 g/L for aeration Basin); Krohne OPTISENS TSS, or Engineer approved equal.
3. Turbidity Transmitter: Quadbeam MXD73 Multi Channel Suspended Solids and Turbidity Transmitter Panel Mount with NEMA 4X enclosure, Krohne MAC 300, or Engineer approved equal.

H. Turbidity/TSS – Flow Through Type for Centrate (Additive Alternate)

1. Valmet LS to be used in association with Valmet Sludge Dewatering Optimizer (SDO)
2. Provide Valmet (SDO) with the following components:
    a. Sludge Dewatering Calculation for Polymer
    b. Valmet Sludge Dewatering Optimizer Base Application
    c. Sludge Dewatering Optimizer for Centrate
    d. Valmet DNA SDO stand-alone cabinet with one ACN Process Controller.

I. Transmissivity.

1. ReatTech M3000 system
2. RealTech system to be supplied with Real Pup Clean System I
3. Sensor: Hach UVAS sc Sensor, Sensorex UVT-LED-SW, YSI UVT-254
4. Controller: Hach SC2000, Sensorex LPM100, YSI IQ SensorNet 282/284 Controller

J. Sensor/Probe Controllers.

1. Hach sc200 or sc1000 series controller.
2. Supply with mounting hardware as shown on the Drawings.

2.2 MASS DENSITY METER

A. Microwave Time of Flight

1. Valmet DS

2.3 FLOW EQUIPMENT FURNISHED

A. Magnetic Flowmeters.

1. Flowtube: Toshiba LF654 Series or Siemens Mag 5100W.
2. Transmitter: Toshiba LF620 Series, or Siemens 6000 Series integral mounting (unless remote mounting required by process conditions or location).
3. Instruments shall be configurable using HART standard communication devices.

B. Thermal Dispersion Air Flowmeters.

1. Thermal Dispersion, insertion-style flowmeter, constructed of all-welded 316L SS wetted parts. NEMA 4X rated
2. Refer to mechanical drawings for pipe material and diameters
3. 4-20mA output with HART communications option.
4. Supply with remote-mounted transmitter and flow conditioner.
5. Meter: Kurz 454 FTB or FCI ST80.
6. Conditioner: as required if upstream and downstream requirements are not sufficient.

C. Ultrasonic Level Transducers and Flow Transmitter.

1. Transducer: Siemens Echomax XPS Series
2. Transmitter: Siemens HydroRanger 200 Series, NEMA 4X enclosure.
3. Configured for Level or Flow measurement as appropriate for application.
4. Supply with one handheld programmer for all HydroRanger transmitters.

D. Non-Contact Flowmeter.

1. TIENeT 360 LaserFlow Velocity Sensor
2. Supply with permanent mounting hardware, sensor retrieval arm, optional ultrasonic doppler level sensor.
3. Configured for Level, Flow, and Velocity measurement as appropriate for application.

E. Metal Tube Rotameters

1. All metal variable area type flow meter designed to measure flow rate of liquids. Rotameter shall consist of a tapered metal tube, an indicating assembly and float. A magnet encapsulated in float couples with rotating magnets connected to an indicating pointer. The the movement of the float shall accurately indicate in terms of flowrate in gallons per minute for water at temperatures of 50 to 80 °F. Visual readings only, no electronic signals for monitoring.
2. Requirements:
   a. Rangeability: 10:1
   b. Accuracy: +2% of Full Flow
   c. Repeatability: 0.5%
   d. Scale Length: 900 Angular
   e. Pressure Rating: 250 psig, minimum,
   f. Allowable Fluid Temp.: 0 to 250° C
   g. Connection: Flanged, or Threaded,
   h. Material of Construction: SS316
   i. Indicator Box: ABS, or Cast AL,
3. Acceptable manufacturers: Krohne, Parker Hannifin, S&K Automation, Brooks, Eureka Industrial Equipment or approved substitution.

2.4 LEVEL EQUIPMENT

A. Submersible Level Transmitters.

1. Dwyer Mercoid PBLTX Series.
2. Contractor to provide 3-1/2" Sch. 40 PVC slotted pipe for stilling well.

B. Ultrasonic Level Transducer and Transmitter.

1. See 2.2 C. above.

C. Float Switch – Type 1.

1. Mercury-free float switch with submersible-rated cable.
2. Siemens 9GEF.
3. Approved alternate: Contegra

D. Float Switch – Type 2.

1. Weighted, cable-suspended float switch.
2. Gems Sensors LS-750.

E. RF Admittance Switch (wafer style ring)

1. Ametek Drexelbook Clear Line Level Switch Type RXX include optional Nema 4 housing with indicator lights. Suitable for sludge applications where required.

2.5 PRESSURE EQUIPMENT

A. Include isolation valve and bleed on all pressure instrument connections

B. Pressure Switches.

1. Weatherproof NEMA 4X housing.
2. 25- 200 psi range.
3. 316SS pressure port and diaphragm with Viton O-ring.
4. Provide with diaphragm seal or inline ring type seal (ring type required for sludge service).
5. DPDT switch rated 5A at 125/250 VAC.
6. Solid State:
   a. IFM PN769X or the Allen Bradley 836P-D
7. Mechanical:
   a. Single stage - Dwyer Mercoid Series 1000W or Onyx valve
   b. Two stage - Onyx valve or Dwyer Mercoid Series 1000W.

C. Progressing Cavity Pump Protection Systems - Pressure Based

1. Onyx Valve Smart Box 4 or engineer approved equal

D. Pressure Gauges.

1. Provide 1% ASME Grade A, open front, 304 stainless steel with 100 mm dial, glycerin-filled pressure gauges.
2. Ring Type: 304 stainless steel.
3. Bourdon Tube: 316 stainless steel.
4. Socket: 316 stainless steel.
5. Range Limits: Vac/15,000 psi.
6. Connection Size & Location: 1/2" NPT – lower.

7. Window: Shatterproof glass.
8. Provide with diaphragm seal/isolator.
    a. Flange Type
        1) WIKA, Ashcroft, Ametek/US Gauge
    b. Inline, Wafer, “Ring” Type (required flor sludge service)
        1) Onyx valve, WIKA, Ashcroft, Ametek/US Gauge

E. Pressure Transmitters.

1. Siemens Sitrans DS III or Allen Bradley 836P
2. Provide with diaphragm seal/isolator
3. Provide inline ring type seal for sludge service.
4. Instruments shall be configurable using HART standard communication devices, or through Studio Logix Designer
5. Provide software for configuration.

F. Differential Pressure Switches.

1. United Electric J402K Series.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install instruments and associated devices. Coordinate exact locations with Engineer as shown on the drawings.

B. Install instruments in various locations in the field and on panels. Coordinate exact locations with Engineer.

C. Coordinate outages and shutdowns with Engineer. Quantity and duration of outages and shutdowns are to be minimized.

D. Starting or stopping of any existing pump; opening any existing breaker, or disconnecting any instrument; shall be approved in advance through the Engineer. All installations shall be in accordance with the Manufacturer's recommendations and instructions.

E. All the necessary mounting accessories shall be provided.

END OF SECTION

SECTION 13422

INSTRUMENTATION ACCESSORIES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of field instrumentation accessories necessary for the complete installation of sensors, meters, switches, transmitters, and similar devices. In particular, each installation shall include the device, mounting stand, where required, and process leads, connectors, valves, support means, and all other devices and material required for a complete installation.

1.2 QUALITY ASSURANCE

A. Referenced Standards.

1. ANSI/IEEE C37-90-1.
2. API RP550.
3. ANSI/ASTM 153.
4. ANSI/ASTM B 62.

B. Factory Testing.

1. Subject each device to a complete functional test.
2. Provide 3-point calibration certificate (NIST traceable) or perform wet flow calibration of flow meters to within specified accuracy.
3. If NIST traceability not provided, submit a certified calibration report for each meter showing results of calibration at a minimum of five points evenly spaced throughout range.
4. Apply a Surge Withstand Capability test wave:
   a. As defined in ANSI/IEEE C37.90-1, to each power supply circuit, battery circuit, signal circuit, output circuit and input circuit.
   b. Application of test wave shall be as described in Section 4 of ANSI C37.90-1.
   c. Submit a certified copy of test showing the no load test waveform, details of test wave generator circuit and description of test conducted.

1.3 SUBMITTALS

A. Product Data. Submit vendor specification information along with a corrected copy of applicable specification form for each device specified in this section.

PART 2 - P R O D U C T S

2.1 UNSCHEDULED DEVICES

A. Hand Valves. Provide process valves at all process taps for isolation of instrumentation equipment except where safety would be compromised by their use.

1. General. Valves must provide straight-through passage and tight shutoff to the rating of the valve.
2. Air Service.
   a. Provide line size ball valve with stainless steel Swagelok body.
   b. Acceptable Manufacturers.
      1) Whitey (www.swagelok.com).
      2) Parker (www.parker.com).

3) Approved substitution.

3. Water service with fluid pressure below 200 psig and fluid temperature below 300 F:
   a. Provide 3/4-inch ball valve with stainless steel swage lock body, disc, union bonnet, and TFE impregnated non-asbestos packing.
   b. Acceptable Manufacturers. Crane No. 431 UB (www.cranevalve.com) or approved substitution.

B. Pulsation Dampener.

1. Provide pulsation dampers where gauges are subject to pulsations and/or where indicated.
2. Provide damping by means of self-cleaning pin or piston.
3. Make provisions to vary amount of damping while preventing accidental shutoff.

C. Receiver Gauges.

1. Calibrate scale in process units with tick marks for milliampere input in engineering units.
2. Provide diode to maintain loop continuity in case of meter movement failure.
3. Accuracy shall be as specified for panel meters.

D. Pressure Gauges.

1. Provide 1% ASME Grade A, open front, 304 stainless steel with 100 mm dial, glycerin-filled pressure gauges.
2. Ring Type: 304 stainless steel.
3. Bourdon Tube: 316 stainless steel.
4. Socket: 316 stainless steel.
5. Range Limits: Vac/15,000 psi.
6. Connection Size & Location: 1/2" NPT – lower.
7. Window: Shatterproof glass.
8. Ashcroft Series 1009 or approved substitution.

E. Pressure Gauge Isolation.

1. In clear fluid service no gauge isolation is required.
2. In service with low concentration of solids (RAW Sanitary Sewage, Stormwater, Clarified Unfiltered effluent) diaphragm seals are to be provided.
   a. WIKA, Ashcroft, Ametek/US Gauge
3. In service with medium concentration of solids (Mixed Liquor, Clarifier Underflow) diaphragm seals are to be provided.
   a. WIKA, Ashcroft, Ametek/US Gauge
4. In service with high concentration of solids (Thickened Solids, Thickener Underflow, Digester Discharge, Cake solids) ring type isolation seals shall be provided.
   a. WIKA, Ashcroft, Ametek/US Gauge

F. Mounting Brackets.

1. 2-5/8-inch channel section.
2. 316 stainless steel.
3. Acceptable Manufacturers:
   a. Unistrut (www.unistrut.com).
   b. Approved substitution.

G. Nameplate.

1. Provide each device with a nameplate identifying tag number and service as specified on device specification form.
2. Make nameplates of 12-gauge stainless steel.
3. Machine-print each nameplate inscription as shown with letters clearly readable from a distance of four feet directly in front of nameplate.
4. Attach nameplates using a minimum of two self-tapping stainless steel sheet metal screws or six-inch length of stainless steel link chain.
5. Name list must be approved by the Engineer before nameplate engraving.
6. External Power Supply. Provide an internal or external on-off switch for each instrument requiring power from an external power source.

H. Surge Protection.

1. Provide surge protection on all 4-20 mA inputs to all analog devices.
2. The surge protection device shall protect field instrumentation from impulses up to 500V or 10,000A induced by lighting strikes or heavy electrical equipment.
3. The protection device shall be NEMA 4X and installed in accordance with manufacturer's recommendations.

I. Instrument Stand.

1. Provide a 52-inch high, 2-inch diameter instrument stand for all instruments mounted from the floor. Stand shall be coated with a Zinc Arc Spray Metallizing for corrosion protection.
2. Acceptable Manufacturers. O'Brien Instruments, FP52.

J. Instrument Sunshield.

1. Provide opaque sunshields for all instruments mounted outside. Sunshields shall provide UV protection to all LCD instrument displays.
2. Provide custom aluminum or stainless-steel sunshields.

PART 3 - E X E C U T I O N

3.1 PREPARATION

A. Coordination. Coordinate equipment delivery with completion of other work to minimize field handling of each device.

B. Verify dimensions in field prior to fabrication.

3.2 INSTALLATION

A. Mount pipe, and connect field devices in accordance with contract drawings, specification and manufacturer's installation instructions.

B. Avoid tubing, piping and conduit interferences.

C. Locate equipment to be accessible for operation, maintenance and replacement.

D. Examine contract drawings and shop drawings for equipment in order to determine best arrangement for work as a whole.

E. Mount field transmitters 40 to 66 inches above floor, work platform, or as sensing line slope requires per manufacturer's guideline. Coordinate tap location and meter location with Engineer prior to beginning work.

F. Where specifications and contract drawings do not delineate precise installation procedures, use API RP550 as a guide to installation procedures. Submit sketch for the Owner's approval prior to installation.

G. Where field devices are shown as yoke mounted on a floor stand, a wall bracket fabricated from two channel sections 1-5/8 inches mounted to a wall or column is considered equal.

H. Make channel section long enough to mount at least two field devices.

I. Use 316 stainless steel for fabrication.

J. Locate instrument-mounting stands within 5 feet of primary element, unless otherwise indicated. Make stands freely accessible.

K. Locate indicating instruments which must be visible for automatic control adjustment or manual operation to be visible from the adjustment or operating point. If plot or piping arrangement precludes this, make other provisions for indication at the adjustment or operation point.

L. Install instrument mounting stands after all conduit and pipe have been installed, except conduit serving devices on stand.

M. Install instrument process piping and tubing from each primary shutoff valve to appropriate gauge, sensor, meter, analyzer, control panel connections, etc.

N. Clean piping, tubing and components thereof prior to installation. This shall include but is not limited to special cleaning procedures for oxygen service when so required.

O. Adjust pulsation dampers to eliminate rapid fluctuations of gauge or switch but to retain sensitivity to pressure changes.

3.3 SUPPORT OF FIELD-MOUNTED INSTRUMENTS

A. Locate field-mounted instruments as shown on drawings or as designated by the Engineer.

B. Secure support pipes, stands or brackets of material with sufficient strength to prevent excess vibration or movement.

C. Locate all transmitters, unless otherwise specified on instrument piping drawings, 40 inches above floor, platform, or as sensing line slope requires per manufacturer's guidance, in a location to allow convenient access for readability, calibration and maintenance.

END OF SECTION

SECTION 13430

SYSTEM CONFIGURATION

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of an instrumentation system for monitoring and control of the treatment process as described herein, and as indicated on the drawings.

1.2 SUBMITTALS

Submit IEC 61131 logic diagrams, graphic screen sketches, description of the loop in his/her own words. The diagrams shall include all PLC logic and computer input/outputs.

PART 2 - P R O D U C T S

2.1 GENERAL

A. Hardware components, equipment, and related items for the instrumentation system shall be as indicated on the drawings and in the specifications.

B. The monitoring and control of various functions of this plant comprise of control narratives as described herein, with a description of instruments and related items given in other sections of the specifications and shown on the drawings. The following description is brief for the purpose of understanding the control philosophy only. Important loops have been described; for the remaining loops, refer to plans and other sections of the specifications.

2.2 HUMAN MACHINE INTERFACE (HMI) -NOT IN CONTRACT

A. Provide proper installation and licensing of the various software packages as defined in the specifications. Demonstrate the redundancy features of the system.

B. Graphical User Interface. When applicable, follow the guidelines when upgrading the screens.

1. Present process information on a set of project specific graphical screens that accurately represent the actual process and facilities.
2. Include navigation aids that logically link screens.
3. Use animation in the form of color-codes, motion, variable fill, and alphanumerical data to alert and inform the operator.

C. Process Monitoring. When applicable, follow the guidelines when developing the screens for process monitoring.

1. Scan, collect and display discrete and analog variables on process graphic displays.
2. Present and organize data on screens to facilitate facility monitoring and control.
3. Organize screens to support operations tasks.

D. Process Control. When applicable, follow the guidelines when developing the screens for process control.

1. Provide for and accept operator entries and commands on the process graphic displays.
2. Integrate operator entry functions into process graphic displays to ease monitoring and control.

E. Alarm Management and Operator Paging. When applicable, follow the guidelines when developing the screens for alarm management and operator paging.

1. Annunciate abnormal conditions and log alarms status (occurrence, acknowledgement, clearance, and reset) changes, as well as designated events.
2. Annunciate alarms on the graphic displays and maintain a summary of active (not cleared, annunciated and reset) alarms.
3. Use color codes to highlight alarm status on graphic and summary displays.
4. Log on the alarm/status printer, alarm and event status changes as they occur.

F. Reporting. When applicable, transfer the reports to the new system.

1. Modify the database links to match the naming conventions created for the project.
2. Follow the guidelines for the format of the reports.
3. Verify the proper operation and accuracy of the data on the reports.
4. Provide the operator with the ability to activate and modify the reports from the process graphic screens.

G. Historical Data Collection. When applicable, follow the data collection requirements when developing the storage and update frequencies of the historical data.

1. Create the necessary database tables to collect and maintain the historical data.
2. Verify the proper collection of the data.
3. Demonstrate the access to the data from periodic reports and/or process graphics.

2.3 PROGRAMMABLE LOGIC CONTROLLERS (PLC) – NOT IN CONTRACT

Program the PLCs in a systematic and organized manner. The programming code shall be fully documented, and provide the same functionality that currently exists.

2.4 REMOTE TERMINAL UNITS (RTU) – NOT IN CONTRACT

Program the RTUs in a systematic and organized manner. The programming code shall be fully documented, and provide the same functionality that currently exists.

PART 3 - EXECUTION

3.1 CONTROL NARRATIVES

Reference Section 13405, Control System Operation, for process control descriptions for each control loop to be monitored and/or controlled by the system.

END OF SECTION

SECTION 13815

LIGHTING CONTROLS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of lighting controls, including lighting contactors, photocells and timers.

1.2 LISTING

All devices shall be UL listed, offer a 5-year warranty and meet all state and local applicable code requirements.

1.3 SUBMITTALS

A. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Deviations from the requirements of this specification shall be clearly indicated in the submittal.

B. Provide product data on dimmers, lighting contactors, timers, occupancy sensors, photocells, wiring devices and plates.

PART 2 - P R O D U C T S

2.1 GENERAL

Lighting controls, including time switches and photocells specified in this section.

2.2 SITE AND EXTERIOR LIGHTING CONTROL

A. Lighting Control Panel.

1. Provide a Lighting Control Panel in the following buildings for controlling all site lighting shown on Sheet E0101.
    a. MCC/Blower Building, SCLP (Site Lighting Control Panel)
2. Provide a UL-listed lighting control panel with one or more factory-installed digital timers, LOCAL/OFF/REMOTE (L/O/R) control circuits, and lighting contactors as indicated on the drawings and specified herein.
3. Provide a sufficient quantity of lighting contactors, each with an adequate number of poles to switch connected lighting fixtures. Provide lighting contactors rated for 30 amps, unless noted otherwise.
4. Reduce the lighting power by 30 percent from midnight to 6 AM in accordance with IECC 2015.

2.3 LIGHTING CONTACTORS

A. Contactor.

1. Configuration. Provide electrically-held magnetic lighting contactor designed to withstand the large initial inrush current lamp loads as well as non-motor (resistive) loads without contact welding.

2. Coil. Provide contactor coil suitable for continuous operation at 120VAC, 60 hertz. Provide coil suitable for continuous operation at other voltages as indicated on the drawings. Coil shall be of molded, encapsulated construction. Permanently mark and/or color code the coil with voltage, frequency and part number.
3. Contacts.
   a. Type. Totally enclosed, double break, silver-cadmium oxide or similar material contacts to minimize sticking or welding. Contact inspection and replacement shall be possible without disturbing line or load wiring. Contacts shall have clearly visible normally open (N.O.) and normally closed (N.C.) contact status indicators.
   b. Rating. 30 amperes for ballasted lighting loads.
4. Auxiliary Contacts. Provide each lighting contactor with the number and type of auxiliary contacts to perform the required functions, plus two spare auxiliary contacts, one normally open and one normally closed.
5. Wiring. The contactors shall have straight-through wiring, with all terminals clearly marked.
6. Line and Load Terminals. Provide captive screws for 30 amp contactors. Terminals above 30 amperes shall be back-out saddle clamp design.

B. Enclosure.

1. Type.
   a. Indoor. NEMA 1.
2. Finish.
   a. Exterior. Electrostatically applied enamel powder-coat. ANSI 61 gray.
   b. Interior. Non-gloss (flat) white.
3. Enclosure shall have extra space to include time clock.

C. Controls.

1. Provide L/O/R control circuit as indicated on drawings.
2. Nameplates. Provide engraved nameplate in accordance with Section 13421, Instruments.

D. Manufacturers. General Electric.

E. Photocontrol and Time Clocks. Provide photocontrol and time clocks in accordance with Section 16145.

PART 3 - E X E C U T I O N

3.1 COORDINATION

Verify that the occupancy sensors are compatible with the specified ceiling systems as indicated on the architectural drawings. Advise the Engineer of any discrepancies before placing the device order.

3.2 INSTALLATION

A. Devices must be completely wired and installed. Lighting fixtures and lighting controls must be operating properly at final completion.

B. Provide hangers and support members for devices as required for proper installation. Provide appurtenances which include stud supports, stems, mounting brackets, frames and plaster rings.

3.3 SITE AND EXTERIOR LIGHTING CONTROL

A. Connect exterior lighting fixtures to lighting contactors provided.

1. Fixtures intended to be switched together shall be connected to poles on the same contactor.
2. Circuits and lighting contactors shall be segregated by voltage (i.e.: only 120 volt circuits on one contactor, only 277 volt circuits on another contactor, etc.).

B. Mount photocell at highest elevation on roof, facing north. Connect photocell to lighting control circuit(s). Adjust Photocell Turn On to appropriate light level (0.75 to 2.5 foot-candles) as directed by Owner.

C. Contractor shall program digital timer for control of fixtures as directed by Owner.

D. Contractor shall verify circuit and contactor ratings for circuits supplying 480VAC fixtures.

E. Conductors for 30 amp, 480VAC site lighting circuits: Use number 8 AWG stranded copper with THHN insulation.

3.4 TESTING

The Contractor shall demonstrate to the Owner the proper operation of all systems and equipment specified in this section. The Contractor shall adjust, repair or replace as necessary all components that do not perform as specified, until able to demonstrate proper operation of equipment in normal, automatic, manual, emergency, power-loss, and power-restored modes of operation, as applicable.

3.5 TRAINING

The Contractor shall provide, at the Owner’s facility, the training necessary to familiarize the Owner’s personnel with the operation, use, adjustment, and problem-solving diagnosis (troubleshooting) of the site lighting control system.

END OF SECTION

SECTION 14600

JIB AND DAVIT CRANES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Section includes the provision of one (1) free standing, removable, portable davit crane, complete with hoist, winch, and removable flush base, for installation at the Headworks Structure. The primary function of the davit crane is to lift Odor Control Media and maintenance items to the upper platform, as needed.

B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) (including paving, wet well slab, drilled piers, etc.) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings.

C. Manufacturer/supplier shall be responsible for the design, manufacture, warranty, service, and operation of all equipment specified herein.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300, Submittals, and Section 01340, Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Engineer review.

C. Shop Drawings. Show details of construction outline dimensions, required clearances with side and end approach travel dimensions of load hooks, total weights and parts identification.

D. Product Data. At time of crane shipment, submit operation instructions, maintenance manuals and spare parts information.

E. Operation and Maintenance Manuals.

1. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730, Operation and Maintenance Data.
2. Installer shall provide a continuing maintenance proposal to Owner, in the form of a standard yearly (or other period) maintenance agreement, which shall state services, obligations, conditions and terms for agreement period and for renewal options.

1.3 QUALITY ASSURANCE

A. The cranes shall be designed and constructed in accordance to latest CMAA specifications. In addition, the cranes shall meet the latest applicable ANSI, AWS, NEC, AISC, OSHA and NEMA specifications.

B. All mechanical parts of the crane system shall be designed to have a minimum safety factor of 5 with capacity load based on the ultimate strength of the material used.

1.4 WARRANTY

Provide equipment warranty in accordance with the requirements of Section 01770, Closeout Procedures.

PART 2 - P R O D U C T S

2.1 DESIGN CRITERIA

A. Removable Davit Crane. A removable davit crane shall be installed at the Headworks structure meeting the following requirements:

1. Capacity: 800 pounds (minimum)
2. Span: 7 feet. (minimum)
3. Lift: 35 feet. (minimum)
4. Base: Flush Mountable & Removable
5. Hoist: Powered Hoist (115V) w/ 10 ft Pendant
6. Trolley: Manual

B. Jib Crane. N/A:

1. Capacity: N/A
2. Span: N/A
3. Height Under Boom: N/A
4. Lift: N/A
5. Base: N/A
6. Hoist: N/A
7. Trolley: N/A

2.2 MANUFACTURERS

A. Subject to compliance with the specific requirements of this section, provide products of one of the following for the Removable Davit Crane:

1. Thern Winches & Cranes.
2. Columbia
3. J. Herbert
4. Or, approved equal

B. Subject to compliance with the specific requirements of this section, provide products of one of the following for the Jib Crane:

1. Gorbel.
2. Konecranes
3. L.K. Goodwin
4. Spanco
5. Or, approved equal

2.3 QUALITY ASSURANCE

A. The cranes shall be designed and constructed in accordance to latest CMAA specifications. In addition, the cranes shall meet the latest applicable ANSI, AWS, NEC, AISC, OSHA and NEMA specifications.

B. All mechanical parts of the crane system shall be designed to have a minimum safety factor of 5 with capacity load based on the ultimate strength of the material used.

C. Comply with AWS standards for workmanship and for qualifications of welding operators.

2.4 PRODUCT DESCRIPTION

A. Crane and Trolley. Powered.

B. Chain Hoist. All hoist units shall be equipped with one holding brake and the braking means to control lowering speed.

C. Painting. All structural parts shall be cleaned of rust and mill scale. The complete crane shall be given the appropriate number of coats of anti-corrosion primer and finish paint to protect surface from environmental damage. Type of paint and color of final coat shall be according to manufacturer's standard.

D. Lubrication. All gear boxes, bearings, etc., shall be properly lubricated prior to shipment from factory. Lifetime lubricated bearings shall be used where possible and appropriate.

E. Materials. Crane shall be constructed of 304 stainless steel.

PART 3 - E X E C U T I O N

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600, Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATION

A. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from shutoff to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Engineer review.

B. Certification of all factory testing data and results shall be submitted for Owner and Engineer review.

3.3 EXAMINATION

Prior to installing cranes, the crane manufacturer and installer shall inspect structure, clearances and all other conditions critical to the installation of the cranes and shall notify Contractor and Engineer in writing of any dimensional discrepancies or other conditions detrimental to the proper installation or performance of the cranes. Contractor shall not proceed with the crane installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.4 INSTALLATION OF CRANES

A. General. Comply with manufacturer's written instructions and recommendations for work required during installation.

B. Welded Construction. Provide welded connections for installation of work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance and replacement on worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Coordination. Coordinate crane work with work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines and levels designated by Contractor to ensure dimensional coordination of the work.

D. Lubrication. Lubricate operating parts of systems as recommended by manufacturers.

3.5 INSPECTION AND TESTING

A. Equipment shall be completely assembled, installed, painted, and approved by the both the manufacturer's factory representative and the Owner's Representative.

B. Upon nominal completion of crane installation and before permitting use of crane (either temporarily or permanently), perform acceptance tests as required and recommended by manufacturer. Minimum testing shall include all standard operations with load of 125 percent of rated capacity.

C. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer's factory representative. Manufacturer's factory representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Engineer.

3.6 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655, Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

END OF SECTION

SECTION 14601

CHAIN HOIST AND TROLLEY

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Section includes the provision of one chain hoist and trolley, for installation on the monorail beam above the proposed blowers within the Blower Building. The function of the monorail crane is primarily to remove blower units from service within the Blower Building. Proposed Blower Building structure is designed for the loadings seen from one (1) 2.5-ton hoist.

B. The Contractor shall be responsible for additional design and costs associated with modifying applicable structure(s) (including paving, Blower Building slab, drilled piers, building columns, etc.) to accommodate equipment with dimensions other than those shown on the drawings. This requirement includes equipment supplied by "Acceptable Manufacturers" that may differ from the dimensions shown on the drawings.

C. All equipment specified under this section shall be provided by a single manufacturer/supplier.

D. Manufacturer/supplier shall be responsible for the design, manufacture, warranty, service, and operation of all equipment specified herein.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300 - Submittals, and Section 01340 - Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, electrical, instrumentation and controls component requirements and drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Engineer review.

C. Shop Drawings/Product Data. At a minimum, provide the following:

1. Equipment cut sheets and product data for the all equipment and products used in the design of the crane system

D. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730, Operation and Maintenance Data.

E. Factory Test and Certification

1. All equipment to be supplied as specified herein shall be tested at the factory for correct operation. Field tests for all equipment shall be made over the components complete operating range, from minimum to maximum capacity. Results of all performance tests, as well as all data taken at the time of testing, shall be submitted for Owner and Engineer review and approval.

F. Certification of all factory testing data and results shall be submitted for Owner and Engineer review.

1.3 WARRANTY

A. Provide equipment warranty in accordance with the requirements of Section 01700, Contract Closeout.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

Description	Blower Building	Units
Installation	Indoors	N/A
NFPA Classification	Class I, Div 2, Group D	N/A
Electrical Requirements	3 Ph/ 460 V/ 60 Hz.; 115 V Control	N/A
Max. Motor Power	15	HP
Duty	Light/infrequent	N/A
Style	Monorail Crane	N/A
Span	17.25	ft
Hoisting Capacity	2.5	Tons
Distance center to center of support columns	8	ft
Overall length of runway beams	23.5	ft
Operating floor elevation	14	ft
Min height to hook from operating floor to highest hook position	10	ft
Distance of pendant control station above operating floor	4	ft
Hook at highest position, El	24	ft
Hook at lowest position, El	5.5	ft

2.2 ACCEPTABLE MANUFACTURERS

A. Provide equipment from one of the following acceptable manufacturers:

1. Konecranes;
2. GH Cranes;
3. Spanco;
4. Cranewerks;
5. Dearborn Crane; or
6. Approved equal.

B. If applicable, all equipment substitution requests shall be made in accordance with the requirements of Section 01600, Materials and Equipment.

2.3 QUALITY ASSURANCE

A. Welding Qualifications. All welding procedures and welding operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of AWS Standard Qualification Procedures. All procedure and operator qualifications shall be in written form and subject to City's review. Accurate records of operator and procedure qualifications shall be maintained by Contractor and made available to City upon request.

2.4 PRODUCT DESCRIPTION

A. The crane shall be single girder type, rigidly supported by end trucks, and shall be designed to run beneath the crane rail. The bridge for the crane shall be constructed to accommodate a bottom-running hoist trolley. The wearing surface of lower flanges shall be either specially fabricated flanges or standard flanges ground smooth. Steel design and fabrication shall comply with applicable portions of the specifications of the American Institute of Steel

Construction. Loadings, impact allowances, and allowable stresses shall be in accordance with the governing standards. Deflection of the main girder shall not exceed 1/800 of the span, with the maximum hoist load at any point.

2.5 CONTROL

A. The monorail crane shall have electric vertical controls and shall be manually adjustable for horizontal positioning. Vertical control of the monorail crane will be provided by a lanyard controller. Controller shall be capable of controlling all aspects of crane function. Controller shall be conveniently located for operator use.

2.6 SPARE PARTS

B. Provide spare parts in accordance with requirements of Section 01700, Contract Closeouts.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

A. Deliver, handle, store, and protect all equipment in accordance with the requirements of Section 01600, Materials and Equipment.

B. Deliver, handle, store, and protect all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.2 FACTORY TEST AND CERTIFICATIONS

A. All equipment supplied that comprise the travelling bridge crane shall be factory tested and certified for operation at the required design condition as well as confirm operation across range of stated capacities.

B. Hoist shall be factory tested and certified for operation at design load capacity.

C. Electrical ratings, power and control connections/wiring, and control system operation shall be inspected and tested for specification conformance prior to shipping.

3.3 INSTALLATION

A. Install all equipment in full accordance with manufacturer/supplier recommendations and/or instructions.

3.4 FIELD INSPECTION AND TESTING

A. Manufacturer’s factory trained service representative shall have minimum 5 years of experience installing/maintaining travelling bridge cranes of design similar to that proposed.

B. Equipment shall be completely assembled, installed, painted, and approved by the manufacturer's factory trained service representative, the Owner’s representative, and the Engineer.

C. Following installation approval, equipment shall be placed in operation under the supervision of manufacturer’s factory trained service representative. Manufacturer’s factory trained service representative shall subsequently provide written certification of proper equipment installation and operation to Owner and Engineer.

D. All system components shall be tested for proper alignment and operation and shall be adjusted as necessary to correct any and all deficiencies and variation from the required characteristics.

3.5 START-UP AND TRAINING

A. Perform equipment start-up in accordance with the requirements of Section 01655, Starting of Systems.

B. Provide field instruction/training regarding equipment operation in accordance with the requirements of Section 01661, Instruction of Operation and Maintenance Personnel.

C. Any special tools or materials required for start-up shall be provided by the manufacturer. A special tool is any tool not readily available from local retail hardware stores.

END OF SECTION

SECTION 15050

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. This Section includes and applies to all work included in Division 15.

B. Work in this Section includes providing labor, materials, equipment, services necessary, fabrication, installation and testing for fully operational and safe systems including all necessary materials , appurtenances and features whether specified or shown in the contract documents or not, in conformity with all applicable codes and authorities having jurisdiction for the following:

1. Mechanical work covered by all sections within Division 15 of the specifications, including, but not limited to:

    a. Heating, ventilating and air conditioning systems and equipment and accessories.
    b. Motors and controllers.
    c. Control systems.
    d. Testing and balancing.
    e. Cleaning of piping systems.
    f. Cleaning of ductwork, casings, plenums, etc.
    g. Dielectric fittings.
    h. Mechanical sleeve seals.
    i. Escutcheons.
    j. Grout.
    k. HVAC demolition.
    l. Equipment installation requirements common to equipment sections.
    m. Painting and finishing.
    n. Concrete bases.
    o. Supports and anchorages.

C. Provide cutting and patching, for the Mechanical Work.

D. Provide piping from plumbing terminations, 10 feet from equipment, for water, gas, compressed air and as indicated.

E. Provide drainage from noted equipment to floor drains, roof drains, sink, or funnel drains.

F. Provide piping connections to equipment, as required, for kitchens, laboratories, laundries, and as indicated.

1.3 DEFINITIONS

A. "Furnish" or "Provide": to supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically otherwise noted.

B. "Install": to erect, mount and connect complete with related accessories.

C. "Supply": to purchase, procure, acquire and deliver complete with related accessories.

D. "Work": labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

E. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

F. "Wiring": raceway, fittings, wire, boxes and related items.

G. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

H. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

I. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

J. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings, in chases, in enclosures, in trenches or in crawl spaces.

K. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

L. "Indicated," "Shown" or "Noted": as indicated, shown or noted on drawings or specifications.

M. "Similar" or "Equal" of base bid manufacture: in the Engineer's opinion, equal in materials, weight, size, design, and efficiency of specified product, conforming with 2.01 MANUFACTURERS.

N. "Reviewed," "Satisfactory," or "Directed": as reviewed, satisfactory, or directed by or to Architect.

O. "Motor Controllers": manual or magnetic starters (with or without switches), individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

P. "Control" or "Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

1.4 ABBREVIATIONS

A. The following are industry abbreviations for plastic materials.

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

B. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

C. Following is a list of abbreviations and symbols that are used in the specifications:

Word or Symbol	Abbreviation or Symbol Used in Specifications
ϕ	phase
air conditioning unit	ACU
alternating current	AC
ampere	amp
brake horsepower (bhp)	BHP
British thermal units	Btu
Celsius	C
cfh	CFH
cubic feet per minute	cfm
cubic feet per second	cfs
degree	°
direct current	DC
emergency power system	EPS
etcetera (etc.)	etc.
Fahrenheit	F
feet	ft.
feet per minute	fpm
gallon	gal.
gallons per minute	gpm
hertz	Hz
horsepower	hp
inches	in.
kilovolt	kV
kilowatt	kW
KVA	kVA
length	length
manufacturer	Mfr.
minute	minute

Word or Symbol	Abbreviation or Symbol Used in Specifications
number	No.
ounce	oz.
percent	%
plus and minus	±
pound or pounds	lb. or lbs.
pounds per square inch (psi)	psi
power factor	pf
psig	psig
PVC	PVC
revolutions per minute (rpm)	rpm
square foot or square feet	sq. ft.
times	times (unless used in an equation, then use x)
uninterruptible power supply (UPS)	UPS
Variable Frequency Drive	VFD
volt	V
water gauge	w.g.
width	width
wire-gauge	awg
WWP	WWP

1.5 UTILITY CONNECTIONS

A. Arrange for and pay utility costs for work of this Division.

B. Included:
1. Connection to utility company mains.
2. Connection to on-site piping mains.
3. Payment of service charges.
4. Provisions for temporary utilities.
5. (Others as required.)

1.6 JOB CONDITIONS

A. Examine all drawings and specifications in a manner to be fully cognizant of all work required under this Division.

B. Adjoining work of other Divisions shall be examined for interferences and conditions affecting this Division.

C. Examine site related work and surfaces before starting work of any Section.

1. Report to Architect, in writing, conditions which will prevent proper provision of this work.
2. Beginning work of any Section without reporting unsuitable conditions to Architect constitutes acceptance of conditions by Contractor.

3. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to Owner.

D. Connections to existing work.

1. Verification of existing:

a. Before submitting bid, become thoroughly familiar with actual existing conditions and systems at the building, and of the existing installations to which connections must be made, including any necessary alterations, and existing building engineering practices and requirements. The intent of the work is shown on the drawings and described herein, and no consideration will be granted by reason of lack of familiarity on the part of the contractor with actual physical conditions, requirements, and practices at the site.

2. Install new work and connect to existing work with minimum interference to existing facilities.
3. Temporary shutdowns of existing services:

a. At no additional charges.
b. At times not to interfere with normal operation of existing facilities.
c. Only with written consent of Owner.

4. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
5. Restore existing disturbed work to original condition.

E. Removal and relocation of existing work.

1. Disconnect, remove or relocate material, equipment, plumbing fixtures, piping and other work noted and required by removal or changes in existing construction.
2. Where existing pipes, conduits and/or ducts which are to remain prevent installation of new work as indicated, relocate, or arrange for relocation, of existing pipes, conduits and/or ducts.
3. Provide new material and equipment required for relocated equipment.
4. Plug or cap active piping or ductwork behind or below finish.
5. Do not leave long dead-end branches. Cap or plug as close as possible to active line.
6. Remove unused piping, ductwork and material.
7. Dispose of removed fixtures and equipment as directed.
8. Turn over removed fixtures and equipment to Owner as directed.

F. Special Traffic Requirements:

1. Maintain emergency and service entrances useable to pedestrian, truck, and ambulance traffic at all times.
2. Where trenches are cut, provide adequate bridging for above mentioned traffic.
3. (Other paragraphs as required).

G. If asbestos insulation is found when working in existing areas, immediately stop work and notify Architect. Do not restart work until advised in writing by Architect that it is safe to do so following abatement, encapsulation, etc.

1.7 CLEARANCE FROM ELECTRICAL EQUIPMENT

A. Piping or ductwork:

1. Prohibited above an area within 5 ft. of:

a. Transformers.
b. Motor control centers.

1.8 SUBMITTALS

A. Submit the following items as hereinafter specified:

1. Names and qualifications of test and balance agencies.
2. Layout Drawings.
3. Coordinated Drawings.
4. As-built Record Drawings (Submitted to Client).
5. Record Files (Submitted to Client).
6. Operating and Maintenance Manuals.
7. Welding certificates.
8. Equipment and material submittals as required by sections within this division.

B. Items shall comply with the requirements as hereinafter specified.

C. Submit shop drawings, product data, samples and certificates of compliance required by contract documents.

D. Schedule of submittals, as agreed to by the Engineer, will set the basis of the minimum required submittals. Submittals shall be provided by the Contractor promptly and in accordance with the Schedule of submittals and in such sequence as to cause no delay in work or in work of any other divisions.

E. Resubmission Requirements:

1. In addition to Division 1 requirements, make any corrections or change in Submittals required. Resubmit for review until no exceptions are taken or a resubmission is not required.
2. Shop Drawings and Product Data:

a. Revise initial drawings or data, and resubmit as specified for initial submittal.
b. Indicate any changes which have been made other than those requested.

3. Samples: Submit new samples as required for initial submittal.
4. Clearly identify resubmittal by original submittal date, number and revision number and indicate all changes from previous submittal.
5. If more than two submissions are required (initial submittal and one resubmittal) based on rejection or lack of compliance by submittal, then the Contractor shall:

a. Arrange for additional reviews by the Design Engineers.
b. Pay all costs for such additional reviews.

F. Corrections or comments made on the shop drawings during review do not relieve the Contractor from compliance with requirements of the drawings and specifications. Shop drawing checking by the Engineer is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for:

1. Confirming and correlating all quantities and dimensions.
2. Selecting fabrication processes and techniques of construction.
3. Coordinating his work with that of all other trades.
4. Performing his work in a safe and satisfactory manner.

G. Substitutions:
1. See Division 1, Substitutions.
2. The bid shall include products per paragraph 2.01 MANUFACTURERS. Engineer will consider formal requests for substitution of products in place of those specified only if these are submitted with the bid for evaluation and in accordance with all conditions specified hereafter.
3. Requests for substitutions after award of contract shall be considered only in case of product unavailability. Product unavailability shall be verified in writing by manufacturer.
4. Submit separate request for each substitution at time of bid, or at appropriate time thereafter in the event of non-availability of item included in bid. Support each request with:

    a. Complete data substantiating compliance of proposed substitution with requirements stated in Contract documents.
    b. Data relating to changes in construction schedule.
    c. Any effect of substitution on other Work in this and other Divisions, and any other related contracts, and changes required in other work or products.

5. Contractor shall be responsible at no extra cost to Owner for any changes resulting from proposed substitutions which affect work of other Sections or Divisions, or related contracts.
6. Claims for additional costs caused by substitution which may subsequently become apparent shall be met by the Contractor.
7. Substitutions will not be considered for acceptance when acceptance will require revision of Contract Documents, unless Contractor bears cost of redesign.
8. Where any redesign of electrical, mechanical or other work is required due to substitution, arrangement or equipment layout other than herein specified or shown:

    a. Arrange for required redesign by Engineer.
    b. Pay all costs for such redesign.
    c. Contractor shall perform such redesign.
    d. Produce detailed plans at no extra cost to Owner.
    e. All subject to Architect's approval.

9. Substitute products shall not be ordered or installed without prior written approval/acceptance by Architect.
10. Engineer will have sole discretion to determine acceptability of proposed substitutions and reserves the right to reject any such substitution.

11. Approval of substitutions shall not relieve Contractor from full compliance with requirements of Contract documents.
12. COORDINATE WITH DIVISION 01, SUBMITTAL PROCEDURES AND SUBSTITUTIONS. IF NECESSARY, ADD THE FOLLOWING SUB-PARAGRAPHS (a) AND (b):
    a. GENERAL CONTRACTOR SHALL REQUEST INDIVIDUAL LAYOUT DRAWINGS FROM MECHANICAL AND ELECTRICAL TRADES, PER SECTION 15050, PARAGRAPH 1.8, AND ELECTRICAL SPECIFICATIONS.
    b. CONTRACTOR SHALL ASSURE THAT EACH MECHANICAL AND ELECTRICAL TRADE HAS COORDINATED WORK WITH OTHER TRADES. STAMP EACH LAYOUT SUBMITTAL AND SIGN TO CERTIFY THAT THESE LAYOUTS HAVE BEEN COORDINATED.

H. Layout (Shop) Drawings:

1. Submit Layout Drawings indicating work within mechanical rooms areas containing boilers, chillers, cooling towers, air handlers or pumps, areas containing acoustically lined ductwork, food service areas and for any areas. See Division 1 specification sections for additional requirements on layout drawings.
2. Layout Drawings for mechanical rooms shall be at a scale of 3/8"=1'-0".

3. Prepare layout shop drawings for all areas.
4. From the layout drawings, prepare and submit Coordinated Drawings as herein specified below.

I. Coordinated Drawings:

1. This Contractor shall prepare coordinated drawings which shall show work of all trades including, but not limited to:
    a. Items noted in the Supplemental General conditions.
    b. Coordinated Ductwork with penetrations at floors, walls, ceiling and roof.
    c. Piping, including:

        1) HVAC and plumbing.
        2) Minor Piping such as drains, air vents, condensate piping, etc.
        3) Sleeves and penetrations.
        4) Expansion devices, anchors, guides and hangers.

    d. Mechanical Equipment.
    e. Supports and suspension devices.
    f. Ductwork/Piping high points and low points.
    g. Electrical Equipment.
    h. Main Electrical conduits and bus ducts.
    i. Equipment support and suspension devices including hangers, supports and bracing.
    j. Structural and architectural constraints including:

        1) Beams, braces, trusses, flanges, constraints, walls, openings ratings, doors, wall types, glazing.

    k. Show location of:
        1) Valves.

2) Piping specialties.
3) Dampers.
4) Access doors.
5) Control and electrical panels.
6) Disconnect switches
7) Others as required.

2. Drawings shall indicate coordination with work in other Divisions which must be incorporated in mechanical spaces.

3. Provide sections and elevations for all mechanical rooms, mechanical areas, areas with routed duct mains, areas with routed piping mains, and areas adjacent to the existing structure.
4. Preparation of drawings:

   a. Prepare reproducible CADD drawings.
   b. Submit to other trades for review of space allocated to all trades.
   c. Revise drawings to compensate for requirements of existing conditions and conditions created by other trades.

5. Final prepared drawings shall show that other trades affected have made reviews and signed, by each trade, at completion of coordination.
6. Coordinated shop drawings shall be for all areas.
7. Contractor is to assure that each trade has coordinated work with other trades, prior to submittal.

J. As-built (Record) Drawings:

1. Provide after installation is complete. Final signoff and Owner acceptance will not occur prior to submission of As-built drawings to Owner.
2. Indicate as-built conditions and all revisions that occurred subsequent to "Coordinated Drawings" submittal, fully illustrating all revisions made by all trades in the course of work.
3. Dimension physical locations of ductwork, and piping with reference elevations and distances above finished floors, below beams, from wall faces, underground (invert elevations) and from column lines.
4. Exact location, type and function of concealed valves, dampers, controllers, piping, air vents, piping drains and isolators.
5. Indicate all equipment sizes and capacities and tag numbers.
6. Provide drawing on reproducible CADD mylar.
7. These drawings shall be for as-built record purposes for the Owner's use and are not considered shop drawings.

K. Record Files:

1. Provide 5 (five) electronic file copies of the As-built CADD drawings in the media (CDROM, Disks, Tape, etc.) of Owner's choice.
2. Include hard copy and electronic copy of file naming convention, layering standards, drawing index and file descriptions.
3. Electronic files shall be modifiable and shall include all associated referenced background files.

L. Operating Instructions, Maintenance Manuals and Parts Lists:

1. Before requesting acceptance of work, submit one set for review by Architect.
2. After review, furnish five printed and bound sets.
3. Include:

    a. Manufacturer's name, model number, service manual, spare-parts list, and descriptive literature for all components, cross referenced and numbered on Record Drawings as required.
    b. Maintenance instructions.
    c. Listing of possible breakdown and repairs.
    d. Instruction for starting, operation and programming.
    e. Detailed and simplified one line, color coded flow and wiring diagram.
    f. Field test report, including:

        1) Instrument set points.
        2) Normal operating valves.

    g. Name, address and phone number of contractors equipment suppliers and service agencies.
    h. Assemble manufacturer's equipment manuals in chronological order, following the specification alpha-numeric system, in heavy duty 3-ring binders clearly titled on the spine and front cover with appropriate index dividers.

M. Quantity of Submittals Required.

1. Layout (Shop) Drawings and Coordinated Drawings:

    a. Submit two prints. Coordinate with project manager.
    b. Upon review, electronic copy will be annotated and returned. Prints will be retained by the Engineer.
    c. Copies of these prints electronic copy will serve as record copies for Architect.

2. Product Data (brochures):

    a. Submit two copies of product data. Provide electronic copy.
    b. Upon review, electronic copy will be returned.
    c. Five copies will be returned.
    d. If comments are required, they will be returned with each copy.
    e. One copy will be retained by the Engineer.

1.9 RELATED WORK AND REQUIREMENTS

A. Requirements of General Conditions and Division No.1 apply to all work in this division.

B. Carefully check the documents of each section with those of other sections and Divisions. Ascertain the requirements of any interfacing materials or equipment being furnished and/or installed by those sections and Divisions, and provide the proper installation and/or required interface.

C. As a minimum requirement and condition, the Contractor shall provide CADD generated drawings (for the purpose of Layout Drawings, Coordinated Drawings, As-

built Drawings and Record Drawings) with a proven layering standard. Deviation from this requirement shall be:

1. At the sole discretion of the Engineer.
2. Submitted as a substitution within the specified time frame.

D. Related work specified elsewhere:

1. Providing temporary heat.
2. Providing finish painting, including pipe stenciling.
3. Access doors.
4. Trench covers and frames.
5. Providing chimney cleanout door and thimble.
6. Cutting and patching, except as noted in "AIA Document A201" and "Supplementary Conditions for Mechanical and Electrical Work.
7. Excavating and backfilling under building.
8. Excavating and backfilling.
9. Louvers in doors.
10. Undercut doors.
11. Wall louvers and screens.
12. Plenums other than sheet metal.
13. Flashing.
14. Shaft gratings.

1.10 QUALITY ASSURANCE

A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

B. Supply all equipment and accessories new and free from defects.

C. Supply all equipment and accessories in compliance with the applicable standards and with all applicable national, state and local codes.

D. All items of a given type shall be the products of the same manufacturer.

E. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

F. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.11 REFERENCE STANDARDS

A. Published codes, specifications, standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Division where cited below:

1. AABC: Associated Air Balance Council.
2. ADC: Air Diffuser Council.
3. AMCA: Air Moving and Conditioning Association.
4. ANSI: American National Standards Institute.
5. ARI: Air-Conditioning and Refrigeration Institute.
6. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers.
7. ASME: American Society of Mechanical Engineers.
8. ASSE: American Society of Sanitary Engineers.
9. ASTM: American Society for Testing and Materials.
10. AWS: American Welding Standards.
11. FM: Factory Mutual.
12. Local Utility Authorities.
13. National, State and Local Codes of all authorities having jurisdiction.
14. NEMA: National Electrical Manufacturer's Association.
15. NFPA: National Fire Protection Association.
16. OSHA: Occupational Safety and Health Act.
17. PDI: Plumbing and Drainage Institute.
18. State Energy Code having jurisdiction
19. UBC: Uniform Building Code.
20. UL: Underwriters' Laboratories, Inc.
21. IMC: International Mechanical Code.
22. IPC: International Plumbing Code.

B. In addition to complying with all other legal requirements, comply with current provisions of governing codes and regulations in effect during progress of the Work, and with the following:

1. Drawings and specification requirements shall govern where they exceed Code and Regulation requirements.
2. Where requirements between governing Codes and Regulations vary, the more restrictive provisions shall apply.
3. Nothing contained in Contract Documents shall be construed as authority or permission to disregard or violate legal requirements. The Contractor shall immediately draw the attention of the Architect to any such conflicts noted in the Contract Documents.

1.12 DESCRIPTION OF BID DOCUMENTS

A. Specifications:

1. Specifications, in general, describe quality and character of materials and equipment.
2. Specifications are of simplified form and include incomplete sentences.
3. Words or phrases such as "The Contractor shall," "shall be," "furnish," provide," "a," "an," "the," and "all" etc. have been omitted for brevity.

B. Drawings:

1. Drawings in general are diagrammatic and indicate scope, sizes, routing, locations, connections to equipment and methods of installation, but not necessarily offsets, obstructions or structural conditions. Locations on drawings may be distorted for purposes of clearness and legibility.

2. Contractor to provide additional offsets, fittings, hangers, supports, valves, drains as required for construction and coordination with work of other trades.
3. Scaled and figured dimensions are approximate and are for estimating purposes only, but shall be followed with sufficient accuracy to coordinate with other work and structural limitations.
4. Before proceeding with work, check and verify all dimensions and carefully check space requirements with other Work to ensure that all equipment and materials can be installed in spaces allotted.
5. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
6. The Contractor is responsible for installing the work in such a manner that it will conform to the structure and architectural elements, avoid obstructions, maintain headroom, leave adequate clearance for proper maintenance and repairs, and provide clearances and access required by codes.
7. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.
8. Above items to be performed at no additional cost to the Owner.

C. If any part of Specifications or Drawings appears unclear or contradictory, consult with Architect and/or Engineer for interpretation and decision as early as possible during bidding period. Do not proceed with such work without Architect's and or Engineer's decision.

D. Typical details, where shown on the drawings, apply to each and every item of the project where such items are applicable. Typical details are not repeated in full on the plans, and are diagrammatic only, but with the intention that such details shall be incorporated in full.

1.13 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

1.14 SPECIAL TOOLS

A. Furnish to Owner at completion of work:

1. One set of any special tools required to operate, adjust, dismantle or repair equipment furnished under any section of this Division.
2. "Special tools": those not normally found in possession of mechanics or maintenance personnel.
3. One pressure grease gun for each type of grease required.

    a. With adapters to fit all lubricating fittings on equipment.

b. Include lubricant for lubricated plug valves.

4. Tag each item and cross reference in Maintenance Manual.
5. Turn over to Owner's representative or temporarily secure to unit at Architect's instruction.

1.15 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Check dimensions of access route through the site from delivery point to final location. Where necessary, ship in crated sections of size to permit passing through available space. Dismantle and/or reassemble, reprovision and retest equipment too large to pass through available access route to final location in one piece.

D. Ship equipment in original packages, to prevent damaging or entrance of foreign matter.

E. Handle and ship in accordance with manufacturer's recommendations.

F. Provide protective coverings during construction.

G. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by Architect.

H. Tag all items with weatherproof tag, identifying equipment by name and purchase order number.

I. Include packing and shipping lists.

J. Special requirements as specified in individual sections.

1.16 PROTECTION OF MATERIALS

A. Protect from damage, water, dust, etc., material, equipment and apparatus provided under this Division, both in storage and installed, until Notice of Completion has been filed.

B. Provide temporary storage facilities for material and equipment.

C. Arrange with Owner for storage facilities for materials and equipment.

D. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.

1. Remove from site and provide new, duplicate, material equipment or apparatus in replacement of that rejected.

E. Cover motors and other moving machinery to protect from dirt and water during construction.

F. Protect premises and work of other Divisions from damage arising out of installation of work of this Division.

1. Repair or replace, as directed by Architect, materials and parts of premises which become damaged as result of installation of work of this Division.
2. Remove replaced parts from premises.

1.17 REVIEW OF CONSTRUCTION

A. Work may be reviewed at any time by representatives of Architect.

B. Advise Architect in writing that work is ready for review at following times:
1. Prior to backfilling buried work.
2. Prior to concealment of work in walls and above ceilings.
3. When all requirements of Contract have been completed.

C. Neither backfill nor conceal work without Architect's consent.

1.18 SCHEDULE OF WORK

A. Arrange work to conform to schedule of construction established or required to comply with Contract Documents.

B. In scheduling, anticipate means of installing equipment through available openings in structure.

C. Confirm in writing to Architect, within 30 days of signing of contract, anticipated number of days required to perform test, balance, and acceptance testing of mechanical systems:

1. This phase must occur after completion of mechanical systems, including all control calibration and adjustment, and requires substantial completion of the building, including closure, ceilings, lighting, partitioning, etc.
2. Submit for approval at this time, names and qualifications of test and balancing agencies to be used.

D. Arrange with Owner schedule for work in each area.

E. Unless otherwise directed by Owner perform work during normal working hours.

F. Work delays:

1. In case noisy work interferes with Owner's operations, Owner may require work to be stopped and performed at some other time, or after normal working hours.
2. Submit, with bid proposal, schedule of hourly rates and overtime premiums.

1.19 NOISE REDUCTION

A. Cooperate in reducing objectionable noise or vibration caused by mechanical systems.

1. To extent of adjustments to specified and installed equipment and appurtenances.

B. Correct noise problems caused by failure to install work in accordance with Contract Documents. Include labor and materials required as result of such failure.

1.20 PERMITS, LICENSES, AND INSPECTIONS

A. Permits and Licenses:

1. Secure required permits and licenses including payments of all charges and fees.

B. Inspections:

1. Obtain certificates of final inspection approval from authorities having jurisdiction, and submit to Architect before acceptance of the Work.
2. Obtain inspections during the Work as required to allow timely progress of these and other trades.

1.21 GUARANTEE

A. Guarantee all materials, equipment, apparatus and workmanship to be free of defective materials and faulty workmanship for period of one year from date of filing of Notice of Completion, unless extended guarantee periods are specified in individual sections.

B. Furnish guarantee covering all work in accordance with general requirements of the Contract.

C. Provide new materials, equipment, apparatus and labor to replace that determined by Architect to be defective or faulty.

D. This guarantee also applies to services such as Instructions, Adjusting, Testing, Noise, Balancing, etc.

E. Equipment manufacturers shall include extended warranty to give full coverage during warranty period, unless longer period is specified. Warranty period commences after substantial completion.

1.22 PRELIMINARY OPERATION

A. Any portion of the system or equipment shall be placed in operation at the request of the Owner prior to the final completion and acceptance of the work. Such operation shall be under the direct supervision of the Contractor.

B. Preliminary operation thereof shall not be construed as acceptance of any part of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Division 15 Sections where articles and subparagraphs introduce lists, the following requirements apply for product selection:

1. Contractor's Options:

a. For products specified only by reference standard, select product meeting that standard, by any manufacturer.
b. For products specified by naming several products or manufacturers, select any one of products and manufacturers named which complies with Specifications.
c. For products specified by naming one product or manufacturer, use that product or manufacturer only.
d. Wherever catalog numbers and specific brands or trade names are used, they are used to establish standards of quality, utility and appearance required.

B. Submission of equipment of manufacturers' other than those specified shall detail equality and difference, item by item.

2.2 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.3 ACCESS DOORS

A. Size for proper access, adjusting and maintenance:

1. 12 in. x 12 in. minimum for valves, trap primers, shock absorbers, etc.
2. 24 in. x 24 in. for man access to concealed fans, coils, etc., unless indicated otherwise.

B. Furnish as required by work in this Division.

1. Access door types as appropriate for receiving.

C. Supply as required by work in this Division.

D. Turn over for setting under trade installing surface on which panels are installed. Direct location and setting, after review by architect.

E. Manufacturers:

1. Access doors:

    a. Karp Associates, Inc.
    b. Higgins Mfg. Co.
    c. Inryco, Inc.: Milcor.
    d. Walsh-Spencer Co.

F. Locate and set after review.

G. Doors, except as noted, flush type with:

1. No. 13 USSG steel door and trim.
2. No. 16 USSG steel frame.
3. Metal wings for keying into construction.
4. Concealed hinges.
5. Stainless steel cam lock, screwdriver operated.
6. Similar to Karp Type DSC-214.
7. Where door cannot swing open:

    a. Lift off type.
    b. With safety wire or chain.
    c. Similar to Karp Type DSC-212.

H. Doors, in acoustic tile ceilings:

1. No. 13 USSG steel frame.
2. No. 16 USSG steel pan-type door suitable for receiving tile thickness.
3. Factory white finish.
4. Stainless steel cam locks:

    a. Screwdriver operated.
    b. Finish flush with tile.
    c. Minimum 2 per door.

5. Hinges: not visible when door is closed.
6. Tile filler: under General construction Work.
7. Similar to Karp Type DSC-210.

I. Doors recessed in plaster ceilings:

1. With recess to receive plaster.
2. Plaster fill: under General Construction Work.
3. Similar to Karp DSC-210-PL.

J. Doors in fire-rated construction:

1. Insulated door panel and frame.

    a. Frame: 16 gauge steel.
    b. Panel: 20 gauge steel.
    c. 2 in. thick fire rated insulation.

2. Conform to requirements of regulating agencies.
3. Rating: UL 1 1/2 hour "B" label, 250^{o}F rating.

4. Continuous hinge with stainless steel pin.
5. Automatic panel closer.
6. Interior latch release.
7. Finish:

    a. Zinc chromate primer.
    b. Rust inhibitive grey paint.

8. Lock:

    a. Self-latching.
    b. Direct action knurled knob.
    c. Flush screwdriver operated.
    d. Key-operated cylinder lock with two keys.
    e. Knurled knob and mortise cylinder. Cylinder replaceable with cylinder for master keying system.
    f. Similar to Karp Type KRP-150 FR.

K. Doors: Shop-painted 1 coat zinc chromate primer.

2.4 ACCESS TILE IDENTIFICATION

A. Buttons, tabs, and markers: to identify location of concealed work.

B. Submit for review.

2.5 MISCELLANEOUS METAL WORK

A. Guards and Railings:

1. Furnish guards and railings as indicated and/or as required by Authorities having jurisdiction.
2. Provide OSHA approved guards for belt drives and rotating equipment.
3. Guards removable with:

    a. Frames: No. 18 USSG steel.
    b. Fronts: No. 20 USSG galvanized perforated steel with:

        1) Covered test openings to permit rpm readings without removal.

    c. Supports: galvanized steel angles or channels, braced to maintain clearances of moving parts.
    d. Clearance for motor adjustment.

4. Railings: removable of 1¼ in. pipe and rail fittings.

2.6 PAINTING

A. Manufacturers:

1. Sherwin-Williams.

2. Pittsburgh Plate Glass Co.
3. Pratt and Lambert.
4. Rust-Oleum.

B. Materials:

1. Best grade for its purpose.
2. Deliver in original sealed containers.
3. Apply in accordance with manufacturers instructions.
4. Heat resistant paint for hot piping, equipment and materials.
5. Colors as selected.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces One-piece or split-casting, cast-brass type with polished chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
k. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Delete first subparagraph below if not required.

        1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Access to Valves and Equipment.

1. Access shall be possible where valves, expansion joints, fire dampers, motors, filters, control devices, and any other equipment requiring access for servicing, repairs, or maintenance are located in walls, chases, and/or above ceilings.
2. Definition of Accessible:

a. Valves and dampers may be operated.
b. Control devices may be adjusted.
c. Fire dampers may be reset.
d. Equipment access panels may be opened.

e. Normal maintenance work such as replacement of filters, lubrication of bearings, etc., may be performed readily within arm's reach of access opening.
f. It shall not be necessary to crawl through furred ceiling space to perform such operations.

3. Group concealed valves, expansion joints, controls, dampers and equipment requiring service access, so as to be freely accessible through access doors and to minimize the number of access doors required.
4. Relocate piping equipment and accessories as required, at no extra cost to afford proper maintenance access.
5. For access into ductwork see Section 15820: Air Duct Accessories.
6. Coordinate location of access panels with applicable trades installing walls or ceiling.

a. Coordinate panel locations with lights and other architectural features.
b. Submit proposed panel locations to Architect for review.

7. Access doors or panels will be installed by the trade furnishing surface on which panels are installed.
8. Arrange for location and marking of removable tiles in splined ceilings where access panels are not installed.
9. Existing Structures:

a. When installation requires access openings through existing construction, provide necessary panels, and arrange for respective trades to provide openings and framing which may be required.
b. Restore adjoining existing surfaces to original condition after new access panels have been installed.

3.6 PAINTING

A. Painting of exposed roof-top equipment.

B. Painting under this Division:

1. Interior of ductwork as far back as visible from outside: flat black.
2. Uncoated hangers, supports, rods and inserts: dip in zinc chromate primer.
3. Factory prime coat for following except as noted.

a. Pumps.
b. Fans.
c. Motors.
d. Equipment.
e. Air outlets.
f. Converter.

4. Marred surfaces of prime coated equipment and piping: spot prime coat to match adjacent coat.
5. Shop prime coat for following, except as noted:

a. Structural frames.

b. Platforms.
c. Ladders.
d. Railings.
e. Tanks.

C. General:

1. Labor, materials and equipment necessary for field painting.
2. Protect flooring and equipment with drip cloths.
3. Paint and materials stored in location where directed.
4. Oily rags and waste removed from building every night.
5. Furnish each space containing stored painting materials with approved 2½ gallon fire extinguisher.
6. Wire brush and clean off all oil, dirt and grease areas to be painted before paint is applied.
7. Mixing:

   a. Mixed and strained as required by manufacturer.
   b. Use thinners only in accordance with manufacturers recommendation.
   c. Follow printed instructions on paint containers. If none are available, instructions shall be obtained in writing from manufacturer.

8. Workmanship:

   a. No painting or finishing shall be done with:

      1) Dust laden air.
      2) Unsuitable weather conditions.
      3) Space temperature below 60°F.

   b. Pipes being painted: containing no heat and to remain cold until paint is dried.
   c. Paint spread: uniform and proper film thickness showing no runs, sags, crawls or other defects.
   d. Finished surfaces shall be uniform in sheen, color, and texture.
   e. All coats to be thoroughly dry before succeeding coats are applied, minimum 24 hrs. between coats.
   f. Priming undercoat: slightly different color for inspection purposes.

9. Exposed, uninsulated, ungalvanized sheet metal other than stainless steel and aluminum: Two coats of aluminum paint or alkyd paint color as directed.
10. Exposed, uninsulated, galvanized sheet metal in finished space including mechanical equipment rooms:

    a. One coat galvanized iron primer.
    b. Two coats alkyd oil paint, color as directed.

11. Exposed, insulated piping and equipment covering:

    a. One coat primer sealer.
    b. Two coats alkyd oil paint, color as directed.

12. Finned tube radiation: One coat factory or field applied coat of heat resisting paint.
13. Paint following with two coats alkyd oil paint, color as directed:

    a. Exposed steel and metal work not furnished with factory-painted finish.
    b. Structural steel supports for piping ductwork and equipment.
    c. Exposed, uninsulated piping.

14. Exposed, uninsulated aluminum sheet metal in finished space:

    a. One coat zinc chromate primer.

15. No paint on exposed, uninsulated stainless steel sheet metal in finished space.

D. Finish painting:

1. Consisting of two finished coats of high gloss medium or long alkyd paint over prime coat.
2. Submit color shade for approval.
3. Piping continuously painted in all exposed areas.
4. Color coding per Section 15075: Mechanical Identification for HVAC piping and equipment

E. Interior of ductwork as far back as visible from outside: flat black.

F. Uncoated hangers, supports, rods and inserts: dip in zinc chromate primer.

G. Factory finish:

1. Steel air outlets in acoustical tile ceilings: baked white enamel.
2. Aluminum air outlets: anodized.
3. Exposed fan coil units: baked enamel.
4. Unit ventilators and unit heaters: baked enamel.

H. Factory prime coat, except as noted:
1. Pumps.
2. Fans.
3. Motors.
4. Equipment.
5. Registers.
6. Diffusers.
7. Grilles.

I. Marred surfaces of prime coated equipment and piping: spot prime coat to match adjacent coat.

J. Shop prime coat for following except as noted:

1. Structural frames.
2. Platforms.
3. Ladders.
4. Railings.
5. Tanks.

3.7 CONCRETE WORK

A. On concrete floors, install equipment on concrete housekeeping pads:

1. Pads 4 in. high unless otherwise noted.
2. Extend 6 in. minimum beyond equipment base, all sides.
3. Concrete work, including forming and reinforcing, under Division 03
   a. Coordinate size and location with General Contractor.
   b. Furnish and locate anchors and anchor bolts.

4. Curbs for field erected plenums similar.

B. Miscellaneous Concrete Items:
1. Concrete work, including forming and reinforcing, under Division 03 (or insert specific Section number for this project.)
2. Concrete for:

   a. Anchor and thrust blocks.
   b. Underground tank hold down slabs.
   c. Pipe trenches.

3. Refer to details on drawings.

C. Provide foundations for:

1. Pumps.
2. Fans.
3. Air handling units and floor mounted plenums
4. Refrigeration equipment.
5. Boilers.
6. Air Compressors.
7. Floor mounted tanks
8. Floor mounted control panels.
9. Motors.
10. Heat exchangers.
11. Convertors.
12. As noted.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.11 EXCAVATION AND BACKFILL

A. Excavate, backfill and restore surfaces inside building.

B. Excavate, backfill and restore surfaces inside and outside building.

C. Excavate, backfill and restore surfaces to 5 ft. outside building.

D. Excavation:

1. Minimum depth, unless otherwise indicated:

    a. Metallic pipe: 24 in.
    b. Non-metallic pipe: 30 in.
    c. Below frost line.

2. If rock encountered:

    a. Excavate to 6 in. below bottom of piping.
    b. Refill with well tamped sand and gravel.

3. Bank excavated materials adjacent to trench as directed.
4. Bank supports:

    a. Sheet-piling, shoring or otherwise properly supported.

5. Install and maintain barricades, signs and lights.

6. Keep excavation free of water with attended pumping equipment.
7. No extra compensation:

    a. For quicksand, hardpan, or other material encountered in excavating.
    b. Except rock on unit price basis.

8. Remove bog or other swampy conditions encountered in excavating to 1 ft. below bottom of piping.

    a. Backfill with well tamped sand, finely crushed stone or gravel.

E. Installation of Underground Piping:

1. On solid undisturbed ground.

    a. Provide firm bed of sand for pipes with any form of protective covering.

2. On concrete or brick piers or cradles:

    a. Unsuitable ground, as directed.
    b. Trench crossings.
    c. Crossing excavation adjacent to building wall or foundations.

3. Bottom of trenches:

    a. Tamped hard.
    b. Graded for required pitch.
    c. Shaped to give uniform support to lower third of full length of pipe.
    d. Recesses excavated for bells and joints.

4. Support and protect piping so it remains in place without settling or damage during and from backfilling.

    a. Replace damaged pipe.

5. Under building:

    a. Temporarily support from below during installation and construction.
    b. Encase in concrete as detailed on Drawings.
    c. Permanently support with U rod hangers.

        1) Ends bent over reinforcing bars in construction above.
        2) Rod materials:

            a) Everdur 651 Alloy.
            b) Double-dipped galvanized steel.

        3) Minimum diameter of rods for following pipe sizes:

Up to 2 in.	3/8 in.
2 ½ to 4 in.	½ in.
5 and 6 in.	5/8 in.
8 and 10 in.	¾ in.

12 to 16 in.	7/8 in.

4) Paint hangers with heavy coat of bitumen solution paint.

F. Backfilling:

1. Immediately after piping installed, inspected, tested and accepted:
2. Remove sheet piling and bracing.
3. Backfill around piping with special care to solidly fill voids without damage to piping.
4. Backfill material.

   a. In accordance with the requirements of Division 02.
   b. Clean loam, clay, sand, gravel or lightweight aggregate:

      1) Sand only up to 6 in. above top of piping with any form of protective covering.
      2) Remainder to be excavated earth free from frozen materials, lumps of clay, rocks, cinders, slag, ashes, organic materials, building or other debris, or refuse.

   c. Install granular pipe insulation around pipe as specified in Section 15080: Piping Insulation.

5. Backfill:

   a. Up to 2 ft. above pipe, hand fill in 4 in. layers.
   b. Remainder, fill in 6 in. layers.
   c. Tamp and puddle each layer before placing next layer.
   d. No stones larger than 2 in. diameter allowed in fill up to 2 ft. above piping.
   e. No stones larger than 4 in. diameter allowed in fill above.
   f. Backfill in manner to prevent future settlement, in accordance with Division 2.
   g. Backfill to required compaction; per ASTM D-1557-587:
      1) 95% under building slabs.
      2) 90% outside of building.

G. Restore existing surfaces disturbed or damaged by excavation and backfilling, including, but not limited to:

1. Turf.
2. Plants.
3. Concrete walks.
4. Asphaltic paving.
5. All other surface improvements.

H. Dispose of acceptable surplus excavation on site as directed.

I. Remove surplus and unsuitable excavated materials from site as directed.

3.12 CUTTING AND PATCHING

A. All carpentry, cutting and patching to be done under trades doing that work.

B. Provide all carpentry, cutting and patching required for proper installation of material and equipment specified in this Division.

C. Do not cut or drill structural members without consent of Architect.

D. All cutting and repairing shall conform to Title 21 of California Administrative Code.

3.13 CUTTING THROUGH CELLULAR FLOORING

A. Cut openings for reception of work:

1. In accordance with manufacturer's recommendations and approval.
2. Not to interrupt continuity of electrical raceways.

3.14 WATER PROOFING

A. Under General Construction Work.

B. Where any work pierces waterproofing, installation shall be subject to review.

1. Provide all necessary sleeves, caulking, flashing and flashing fittings required to make openings absolutely watertight.

C. Flashing:

1. 6 lb. lead.
2. 16 oz. lead coated copper.
3. No.22 USSG aluminum.
4. Fittings for piping through roof:

a. Galvanized cast iron bottom recess roof type.
b. Similar to Josam No. 26440 or No. 26450.

D. Provide weather protection canopies, hoods or enclosures over out-of-door equipment which could be damaged by exposure to weather.

1. This requirement applies to:

a. Damper operators.
b. Damper bearings.
c. Controls.
d. Instruments.

2. See other sections in this Division for application of this requirement to motors, drives, ducts, and fans, etc.
3. Identify items under such covers if entirely enclosed.

3.15 CLEANING AND ADJUSTING

A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.

B. Painted or exposed work soiled or damaged: clean and repair to match adjoining work before final acceptance.

C. Remove debris from inside and outside of materials and equipment.

D. Flush out piping after installation.

E. Clean piping systems as described in Division 15, Section Hydronic Piping.

F. Adjust valves and automatic control devices.

G. Traps, wastes and supplies: unobstructed.

3.16 FIELD QUALITY CONTROL

A. Tests:

1. Perform as specified in individual sections, and as required by authorities having jurisdiction.
2. Duration as noted.

B. Provide required labor, material, equipment, and connections.

C. Furnish written report and certification that tests have been satisfactorily completed.

D. Repair or replace defective work, as directed.

E. Pay for restoring or replacing damaged work due to tests, as directed.

F. Pay for restoring or replacing damaged work of others, due to tests, as directed.

3.17 TRAINING

A. Provide training by qualified manufacturers' representatives for equipment as specified in this Division.

B. Training to include:

1. Site-specific training.
2. Minimum hours as specified in each Section.
3. Training materials (minimum six sets).
4. Videotapes (2 copies) of each training session upon completion.

C. Each training session to be scheduled with Owner at least 30 days in advance.

END OF SECTION

SECTION 15051

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

1.4 Manufacturers:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Baldor
2. General Electric
3. Toshiba
4. AO Smith
5. U.S. Motors
6. Dayton
7. Marathon
8. WEG (1 hp and above)

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1, including applications of premium efficiency motors.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Bearings shall have a life grade of L5 with a minimum of 50,000 hours.

K. Motors shall have permanently greased bearings where possible. Where not possible, grease ports shall be provided with adequate access. Grease capillaries are not allowed.

L. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

M. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Provide shaft grounding ring on motors 5 hp and greater.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 15052

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.
5. Sleeves.
6. Grout.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2. Where Basis of Design product is indicated, provide that item or a manufacturer listed or equal. For manufacturers not listed, submit substitution only at time of bid with complete comparison to specified item.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
3. Aboveground Pressure Piping: Pipe fitting.

B. Adapters:

1. Tile-cast iron adapters with extra heavy cast iron hub and spigot type, equal to Josam Series 88700.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F. Shall be listed under ASSE Standard No. 1079.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.

b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Seal space between pipe and sleeves through exterior walls and fire and smoke-rated walls and floors in accordance with local code and Fire Department requirements.
2. Fire rated construction: Space between pipe and sleeve shall not exceed one-half inch. Provide close fitting metal escutcheons on both sides of sleeves through fire-rated construction.

a. Sealant material shall be non-combustible and smoke-tight, equal to Nelson Flameseal system using ceramic fiber insulation plus putty. Install in accordance with manufacturer's recommendations.
b. Sealant material shall be non-combustible and smoke-tight.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
5. Provide projecting flashing sleeve through interior membrane waterproofed floors, except as noted. Provide cast iron sleeve with integral flashing flange for built up membrane with clamping ring, equal to Smith No. 1760. Provide integral or brazed four-inch wide flange on sleeve for floors with liquid membrane waterproofing, equal to Smith No. 1755. Adjust sleeve height to floor construction with galvanized steel pipe nipples top and bottom extending two inches above finished floor.
6. Provide flush flashing type sleeve for installation through membrane-waterproofed walls, floors for floor outlet fixtures, slabs with earth fill above, and slabs on ground. Provide cast iron sleeve with integral flashing flange and clamping ring for floors with built up membrane, equal to Smith No. 1721. Provide sleeves with integral or brazed four-inch wide flange for floors with liquid membrane, equal to Smith No. DX-1721. Modify sleeve length for wall or slab thickness. Seal pipe watertight in sleeve with oakum packing and caulked lead joint.
7. Provide galvanized cast iron sleeve with integral bottom flange, through floors with elastomeric type waterproofing, equal to Smith No. DX-9325.
8. Provide No. 22 USSG galvanized iron U-shaped covers over water piping installed in floor fill. Surround covers and drainage and vent piping with a minimum of one-half inch of cement mortar.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
4. Provide continuously welded center flange in sleeve though exterior walls, interior floors of machine rooms and sprinklered areas and fireproof floors.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

B. Provide labor, materials, and equipment necessary for field prime painting. Protect flooring and equipment with drop cloths and store paint and materials in a location where directed. Using wire brush, remove oil, dirt, rust and grease before applying paint.

C. Apply a heavy coat of bituminous solution paint on piping in concrete or cinder fill or exposed above roof and on underground joint clamps.

D. Apply epoxy primer for steel piping, cast iron piping (except underground), and all steel and iron work.

E. Dip in epoxy primer, uncoated hangers, supports, rods and inserts.

F. Epoxy primer shall be Sherwin Williams MIL-P53022B, or approved equal.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 15060

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

D. Where thermal movement in pipe line occurs, hanger assembly shall support pipe line in all operating conditions.

1.5 SUBMITTALS

A. Product Data: Manufacturer's catalog data, including load ratings, dimensions and installation instructions, for the following:

1. Steel pipe hangers and supports.
2. Fiberglass pipe hangers.
3. Thermal-hanger shield inserts.
4. Powder-actuated fastener systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Fiberglass strut systems. Include Product Data for components.
4. Pipe stands. Include Product Data for components.
5. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

B. Codes and Standards: Provide pipe hangers and supports conforming to the following:

1. American Society of Mechanical Engineering:

a.	B31.1	Power Piping.
b.	B31.5	Refrigerating Piping and Heat Transfer Components.
c.	B31.9	Building Services Piping.

2. American Society for Testing and Materials (ASTM):

a.	A36	Standard Specification for Carbon Structural Steel.
b.	A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
c.	A307	Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength.

d. A575 Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
e. D695 Compressive Properties of Rigid Plastics.
f. D790 Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
g. F708 Standard Practice for Design and Installation of Rigid Pipe.

3. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

a. SP58 Pipe Hangers and Supports - Materials, Design And Manufacture.
b. SP69 Pipe Hangers And Supports – Selection And Application.
c. SP89 Pipe Hangers And Supports – Fabrication And Installation Practices.
d. SP90 Guidelines on Terminology for Pipe Hangers and Supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.

14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 FIBERGLASS STRUT SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Champion Fiberglass, Inc.
3. Cope, T. J., Inc.; Tyco International Ltd.
4. Seasafe, Inc.

2.6 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
1. Insulated pipe shields by Mechanical Pipe Shields MFG., "SNAPPITZ", may be utilized as an alternative to above.

D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
1. Insulated pipe shields by Mechanical Pipe Shields MFG., "SNAPPITZ", may be utilized as an alternative to above.

E. Insert and shield shall cover entire circumference of pipe.

F. Insert Length: Extend a minimum of 2 inches beyond sheet metal shield.

2.7 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.

f. Powers Fasteners.

2.8 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers:

a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Portable Pipe Hangers.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturers:

a. Portable Pipe Hangers.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

C. Hanger Rods: ASTM A 575, hot rolled Steel, ANSI B1.1 threads, continuously threaded, with electro-galvanized finish.

D. Steel Pipe Columns: ASTM A 53, Schedule 40, black steel.

E. Bolts and Nuts: ASTM A 307, Grade A, regular hexagon-head type.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate insulation.
6. Inserts of length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

O. Outdoor Piping: Pipe hangers, supports and hardware including screws, bolts, nuts, and washers, located outdoors shall be hot-dip galvanized in accordance with ASTM A123.

P. Miscellaneous Steel: Provide miscellaneous framing, steel members, beams, brackets, etc. for support of work in Division, unless specifically included in other Divisions.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1M procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 1050 deg F pipes, NPS 4 to NPS 16, 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-Adjustment 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.
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 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 24, if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of standard length.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe. See section 2.6, "Thermal-Hanger Shield Inserts".

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb 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 absorb 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 absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Supports of wire rope, wood, chain, strap perforated bar or any other makeshift device shall not be permitted.

END OF SECTION

SECTION 15071

WASTEWATER PIPING

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of all labor, supervision, materials, tools, equipment, and related items necessary for the furnishing and installation of wastewater process piping systems, potable and non-potable water (service water) systems, chemical piping systems, and other piping systems not described in other sections of these specifications.

1.2 REFERENCE STANDARDS

A. American Water Works Association (AWWA).

B. American National Standards Institute (ANSI).

C. American Society of Testing Materials (ASTM).

1.3 SUBMITTALS

A. Submit shop drawings and product data in accordance with the requirements of Section 01330, Submittal Procedures.

B. Submit Manufacturer's certifications that supplied pipe and fittings meet provisions of this Section and have been tested to meet any applicable ANSI standards.

C. Contractor to review and submit manufacturer's recommended installation procedures.

PART 2 - P R O D U C T S

2.1 PIPE SCHEDULE

A. Pipe Designation. Following is a description of the various wastewater piping system designations. Pressurized service is defined as pipe conducting fluids mechanically or by gravity under head conditions of 5 psi (11′-6″) or greater. Non-pressurized service is defined as pipe conducting fluids by gravity under head conditions less than 5 psi (11′-6″).

B. Service Description (Service Abbreviation).

1. Potable Water (PW).
2. Non-potable Water (NPW), also referred to as service water.
3. Process Air (PA).
4. Pressurized Sewage and Sludge (RAW, RAS, SC, SL, TAS, WAS, STM).
5. Non-Pressurized Sewage and Sludge (CEF, PEF, MLQ, PD, SC, SAN, STM).
6. Pressurized Grit (GRT).
7. Chemical Feed (CLS, PMR).

C. Pipe Materials. Following are the materials of construction for the piping system designations depending on size and whether installed above or below ground.

1. Potable and Non-potable Water.
   a. Above Ground.
      2-1/2 inch and smaller — Galvanized steel, copper
      3 inch and larger — Ductile iron, Galvanized steel
   b. Buried.
      2-1/2 inch and smaller — Galvanized steel, copper, PVC, HDPE
      3 inch and larger — Ductile iron, PVC, HDPE
2. Process Air.
   a. Above Ground
      2-1/2 inch and smaller — Galvanized steel, 316 Stainless steel
      3 inch and larger — Ductile iron, Galvanized steel, 316 Stainless steel
   b. Buried.
      2-1/2 inch and smaller — Galvanized steel
      3 inch and larger — Ductile iron, Galvanized steel, 316 Stainless steel
3. Pressurized Sewage and Sludge (5 psi and greater).
   a. Above Ground.
      2-1/2 inch and smaller — Galvanized steel
      3 inch and larger — Ductile iron
   b. Buried.
      2-1/2 inch and smaller — Galvanized steel, PVC, HDPE
      3 inch and larger — Ductile iron, PVC, HDPE
4. Non-pressurized Sewage and Sludge (less than 5 psi).
   a. Above Ground.
      2-1/2 inch and smaller — Galvanized steel
      3 inch and larger — Ductile iron
   b. Buried.
      2-1/2 inch and smaller — Galvanized steel, PVC, HDPE
      3 inch and larger — Ductile iron, FRP, PVC, HDPE
5. Pressurized Grit.
   a. Above Ground.
      2-1/2 inch and smaller — Galvanized steel
      3 inch and larger — Ductile iron (lined)
6. Chemical Feed.
   a. Above and Below Ground.
      2-1/2 inch and smaller — CPVC, 316 Stainless steel
7. Temporary Piping. Provide either steel or HDPE pipe, sized as shown on drawings, with sufficient working pressure and thickness to withstand 150 percent of the system pressure. Temporary piping is the property of the Contractor. At the completion of use, it shall be cleaned and removed from the site.

2.2 STEEL PIPE

A. Pipe and Fittings, 2-1/2 inch and Smaller.

1. Steel pipe shall conform to ASTM A120, except that spiral lap welded pipe may not be used. If galvanized, it shall be in accordance with ASTM A120. Unless otherwise specified or shown on the drawings, all pipe shall be Schedule 40. All pipe for grit service shall be schedule 80.
2. Fittings for use with steel pipe with threaded joints shall be 150-pound malleable iron screwed fittings in accordance with ANSI B16.3. Provide pipe with American Standard taper pipe threads. Unions shall be 150-pound malleable iron, ground-joint unions with bronze seat.

B. Pipe and Fittings, 3-inch and Larger.

1. Steel pipe shall conform to ASTM A53, except that spiral lap welded pipe may not be used. If galvanized, it shall be in accordance with ASTM A53. Unless otherwise specified or shown on the drawings, all pipe shall be Schedule 40, while all process air pipe 3 inches and larger in diameter shall be Schedule 10.
2. Joints, unless otherwise noted, may be welded or flanged. In general, pipe 3 inches and over in diameter shall be flanged and pipe under 3 inches shall be screwed.
3. Steel pipe 6 inches in diameter and over shall be in accordance with AWWA C200, except that butt strap, riveted or swaged joints shall not be used, and spiral lap welded pipe shall not be used. Unless indicated otherwise, pipe wall thickness shall not be less than that conforming to standard weight pipe.
4. Use fittings of same size as pipe they serve. Reducers are not permitted to facilitate on off-size fitting. Reducing bushings are also prohibited. Reduction in piping size will be made by reducing fittings. Fittings shall be lined and coated as specified for pipe they serve. Fittings for use with galvanized pipe shall be galvanized in accordance with ASTM A153.

C. Welding Fittings. Welding fittings for use with welded steel pipe shall be forged steel fittings in accordance with ANSI B16.9, standard weight.

D. Joints. Unless otherwise noted, pipes may be joined by using joints that are screwed, welded, flanged or grooved. In general, pipe three inches and over in diameter shall be flanged or grooved and pipe less than three inches shall be screwed. Flanges for steel pipe with screwed joints shall be cast iron companion flanges in accordance with ANSI B16.1, Class 125. Welding flanges for steel pipe shall be steel flanges in accordance with AWWA C207, Class D, or welding slip-on flanges conforming to ANSI B16.5, Class 150, with flat face. Use welding neck type flanges on all fittings. Grooved end couplings shall be Victaulic Style 77, standard rigid, or approved substitution. Provide sleeve-type flexible joint when designated or required by Contractor for flexibility - Joint types for air service shall comply with the following:

1. Sleeve-type flexible couplings shall be Victaulic, Depend-O-Lok, ExE series or approved substitution.

2. Sleeve-type expansion couplings shall be Victaulic, Depend-O-Lok, FxE series or approved substitution.

3. Sleeve-type restraint couplings shall be Victaulic, Depend-O-Lok, FxF series or approved substitution.

E. Gaskets. Gaskets used in conjunction with airlines shall be EDPM gaskets suitable for temperatures to 230° F.

F. Dissimilar Metals. Make joints between copper and steel pipe or equipment using insulating unions such as Crane Company No. 1259; EPCO as manufactured by EPCO Sales, Inc.; or approved substitution.

2.3 STAINLESS STEEL PIPE

A. Pipe. Stainless steel tube 3 inches and larger shall conform to the requirements of ASTM A312 and shall be of the grade and schedule specified in the table below.

1. For service pressures to 150 psi with operating temperatures to 200 degrees F, the following wall thicknesses shall be specified as a minimum:

Nominal Dia.	Schedule
10" or Less	5S
12"	10S
14"	10s
16"	10S
18"	10S
20"	10S
24"	10S
30"	10S

For low pressures air service (0-25 psig) the following pipe schedule shall be specified as a minimum;

Nominal Dia.	Schedule
10" or Less	5S
12"	10S
14"	10s
16"	10S
18"	10S
20"	10S
24"	10S
30"	10S

Note: These wall thicknesses are equal to or greater than are required for 150 psi service by a margin of safety of 4 to 1 as applied to theoretical bursting pressures to which has also been applied to a weld joint efficiency of 70%. The total safety factor is approximately 5 to 1 considering worst case wall thickness variation of 12-1/2% below normal gauge or schedule thickness.

Wall thicknesses for pipe over 24-inch diameter are to be calculated using a safety factor of 5 to 1 applied to Barlow's formula: t(wall thickness) = PD/2S.

B. Fittings. Stainless steel tube size fittings 3 inches and larger shall conform to the requirements of ASTM A-774-80 and shall be of the grade and schedule (wall thickness) specified in the table above. Elbows shall be dir-formed, long radius (1-1/2 x d) through 18-inch diameter. Five segment mitered elbows may be supplied above 18 inches.

C. Joints. Stainless steel tube fabricated onto spool pieces shall have shop welded circumferential butt weld joints, or Vanstone joints using angle face rings with backing flanges drilled to ANSI B16.1, Class 125 standards. Backing flange thicknesses to be 1/2" for 3" to 8" diameter, 5/8" for 10" to 18" diameter, 3/4" for 20" diameter, 1" for 24" to 30" diameter and 1-1/4" for 36" diameter tube. Backing flanges to be prime painted steel plate flanges, except in the case of submerged joints in which case they are to be stainless steel plate flanges. (Galvanized back up

flanges are to be provided where deemed necessary by the Engineer.) Provide sleeve-type flexible joint when designated or required by Contractor for flexibility. Joint types shall comply with the following:

1. Sleeve-type flexible couplings shall be Victaulic, Depend-O-Lok, ExE series or approved substitution.

2. Sleeve-type expansion couplings shall be Victaulic, Depend-O-Lok, FxE series or approved substitution.

3. Sleeve-type restraint couplings shall be Victaulic, Depend-O-Lok, FxF series or approved substitution.

D. Gaskets. Gaskets used in conjunction with airlines shall be EDPM gaskets suitable for temperatures to 230° F.

E. Hangers and Supports. Hangers and support components in contact with tube or pipe shall be made of stainless steel, fiberglass or insulated against dissimilar metals. Support spacing shall be in conformance with Section 15094, Supports and Hangers.

F. Materials used in tube and fitting manufacture shall confirm to ASTM A-240 furnished in the cold rolled sheet finish through 1/4-inch thicknesses and in the #1 plate finish over 1/4-inch thickness. Chemical and physical material certificates to be available upon request. All tubular products to be immersion pickled subsequent to manufacturing and fabrication operations and prior to shipping to point of installation. Only extra low carbon (ELC) materials with .03% max carbon shall be used for pipe and fitting manufacture.

G. Diameter tolerances and wall thickness tolerance of tubular products are to conform to ASTM A-530.

H. Workmanship on spool fabrication shall be of the highest quality and appearance. Fabricators shall have had a minimum of five years experience supplying stainless steel.

1. Only weld procedures that have been qualified under ASME Section IX and only welders who have successfully completed performance qualifications tests per ASME Section IX on is these qualified procedures shall be utilized in pipe spool fabrication.
2. Only inert gas shield welding processes, namely, GTAW (TIG), GMAW (MIG), PAW (plasma arc welding) shall be used in spool fabrication.
3. Inert gas shielding shall be utilized on the back as well as the torch side of a weld joint to prevent atmospheric contamination of the molten and adjacent material.
4. Filler metal shall be added to all welds to provide a cross section of weld metal equal to or greater than parent metal.
5. Butt welds shall have 100% penetration to the interior or back side of the weld joint.
6. Weld joints shall be accurately fitted and cleaned of all foreign material prior to welding.
7. Weld reinforcement on both sides of the weld shall be smooth, uniform and no more than 1/16 inch in height.
8. Weld concavity and undercut shall not be acceptable on either side of the weld.
9. Only extra low carbon (ELC) filler metals shall be used.
10. Each spool piece shall be marked with identification relatable to the spool drawing and or system line to facilitate job assembly.
11. Spools shall be fabricated to the "Pipe Fabrication Institute" fabricating tolerances ES-3 (1981).
12. All spool pieces shall be immersion pickled after fabrication and prior to shipping in a pickling solution of 6-10% nitric acid and 3-4% hydrofluoric acid. Temperature and exact concentrations to be such that only a modest etch is produced but that all oxidation and ferrous contamination is removed from the metal surface. All residues of the pickling solution are to be neutralized after pickling. Backing flanges shall be secured to pipe ends for shipping protection and pipes pools shall be loaded and blocked and lagged as necessary to ensure protection from damage during shipping.

2.4 DUCTILE IRON PIPING SYSTEMS

A. Pipe and Fittings.

1. Pipe shall conform to AWWA C150 and AWWA C151, thickness Class 51.
2. Fittings shall be ductile iron manufactured in accordance with AWWA C110.
3. Coating.
   a. Exterior Coating. Provide standard 1-mil-thick bituminous coating on outside of pipe and fittings for cement-mortar lined pipe or ceramic epoxy lined pipe. For ceramic epoxy lined pipe, ceramic epoxy coating will also be allowed (Cermapure PL90). For exposed pipe and fittings to be painted, provide elastomeric polyurethane or premium epoxy per Section 09928, Protective Coatings for Wastewater Systems.
   b. Interior Coating. Provide cement-mortar lining conforming to AWWA C104 or ceramic epoxy lining conforming to ASTM E-96, ASTM B-117. ASTM G-95, ASTM D-714, and ASTM G-22 . Protecto 401 or approved substitution, for non-cement-mortar lined pipe.
4. Provide ceramic epoxy ductile iron pipe and fittings for all pipe sizes used for pressurized grit service.
5. Provide polyethylene encasement in accordance with AWWA C105 for buried service. Polyethylene shall be ASTM D1248, Type I, Class C (black), and Grade E-1 with a minimum nominal thickness of 8 mils.

B. Joints. Provide flanged or grooved-end type joint for aboveground service and push-on and restrained type for buried service unless otherwise designated. Provide sleeve-type flexible joint when designated or required by Contractor for flexibility. Joint types shall comply with the following:

1. Flanges. Ductile screwed on threaded end of pipe, conforming to ANSI B16.1, Class 125. Attachment, aligning and facing shall conform to AWWA C115.
2. Mechanical or Seal Type. Joints for buried ductile iron pipe shall be mechanical or boltless gasket-seal (Tyton, Fastite) type and shall conform to AWWA C151 or C153 and AWWA C111.
3. Sleeve-type flexible couplings shall be Dresser Style 53, Smith-Blair type 400 series, or approved substitution.
4. Flanged adapter couplings shall be Dresser Style 127, Smith-Blair 900 series, or approved substitution.

2.5 FIBERGLASS REINFORCED PLASTIC PIPING SYSTEMS (FRP)

A. Pipe and Fittings.

1. Provide centrifugally cast, fiberglass-reinforced polyester pipe, fittings and joints manufactured in accordance with ASTM D3262, ASTM D3754 and AWWA C950.
2. Pipe outside dimensions shall be in accordance with AWWA C151 and C950.
3. Pipe shall have a minimum pipe stiffness of 46 psi (SN46) for non-pressure service and a pressure class of 100 psi (PN150) for pressure service.
4. Pipe and fittings shall be as manufactured by Hobas USA, Inc or approved substitution.

B. Joints.

1. Provide fiberglass sleeve couplings that utilize elastomeric sealing gaskets made of EPDM rubber compound. Joint shall meet performance requirements of ASTM D4161.
2. For connections to concrete structures, provide spigot with elastomeric gasket contained in a groove. Provide the fabricated steel companion, complete with 2-1/2-inch wide seal ring for casting in wall of structure.

2.6 HIGH DENSITY POLYETHYLENE PIPING SYSTEMS (HDPE)

A. Pipe and Fittings.

1. HDPE pipe and fittings shall be made of high density, high molecular weight polyethylene pipe material complying with the requirements of ASTM D3350, cell classification PE 345434C or 435400C. Dimensions and workmanship are specified by ASTM F714 or ASTM F2736.
2. Pipe shall have a minimum SDR 26 or minimum pipe stiffness of 46 psi when tested in accordance with ASTM D2412 for non-pressurized service and a minimum pressure rating of 150 psi for pressure service.
3. Polyethylene pressure pipe and fittings for 1/2 inch through 3 inches shall comply with the requirements of AWWA C901, pressure class 160.
4. All molded and fabricated fittings shall be rated at same pressure as the pipe.

B. Joints.

1. Joined using a heat fusion technique called "butt fusion."
2. Provide convoluted backup flanges constructed of ductile iron, ASTM A536, Grade 65/45/12, ANSI B16.5 dimensions, used in conjunction with molded stub ends which are butt fusion to HDPE pipe, for connections to cleanouts, valves and aboveground piping.
3. Slip Joints conforming to ASTM 2312, spigot shall have two gaskets meeting the requirements of ASTM F477.

2.7 CHLORINATED POLYVINYL CHLORIDE PIPE SYSTEMS (CPVC)

A. Pipe and Fittings.

1. CPVC pipe, Schedule 40 and 80, shall be Type IV, Grade 1, manufactured in accordance with ASTM F441 with threaded or solvent welded socket fittings. All pipe to be threaded or used for chemical service shall be Schedule 80.
2. CPVC pressure pipe shall comply with the requirements of ASTM D2837 for sizes 1/4 inch to 12 inches.

B. Joints.

1. CPVC pipe Schedule 40 and 80. Unless otherwise noted, joints may be solvent welded or screwed.
2. CPVC threaded joints shall be Schedule 80, manufactured in accordance to ASTM F437 for sizes 1/4 inch to 6 inches.
3. CPVC Schedule 40 and 80 socket joints shall be manufactured in accordance to ASTM F441 for sizes 1/4 inch to 12 inches.

2.8 POLYVINYL CHLORIDE PIPE SYSTEMS (PVC)

A. Pipe and Fittings.

1. PVC pipe, Schedule 40 and 80 shall be Type 1, Grade 1, manufactured in accordance with ASTM D1784 and ASTM D1785, with threaded or flanged fittings. All pipe to be threaded shall be Schedule 80.
2. PVC sanitary sewer pipe, rubber gasket and fittings shall comply with the requirements of ASTM D3034 (SDR35) for sizes 4 inches through 15 inches, and ASTM F679 (PS 115) for sizes 18 inches through 27 inches. This pipe intended for gravity manhole to manhole connections.
3. PVC pressure and non-pressure process pipe shall comply with the requirements of AWWA C900, pressure class 150 psi, for sizes 4 inches through 12 inches; AWWA C905 (DR18) for 14 inches to 48 inches. Fittings shall be ductile iron for pipe 4 inches and larger.

B. Joints.

1. PVC pipe Schedule 40 and 80. Unless otherwise noted, joints may be solvent welded, screwed, or flanged. Flanges shall be one-piece, molded hub type, flat face, 125 pound. Gasket shall be full face.
2. PVC gravity sewer pipe joint to be bell and spigot conforming to requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477.
3. PVC pressure and non-pressure process pipe joints shall be ductile iron bell and spigot, flanged, and mechanical joint. Provide tapping saddles for service connections.

2.9 COPPER PIPE

A. Pipe. ASTM B88, Type K or L. Use Type K below ground and Type L above ground.

B. Fittings.

1. Flared. ANSI B16.26.
2. Solder. ANSI B16.22.
3. Compression. Crawford "Swage-Lok", Parker "Intru-Lok", or approved substitution.

C. Union.

1. Threaded. American Sanitary "Dielectric Coupling," Ecoff Products "EPCO Dielectric Unions," or approved substitution.
2. Flanged. Dielectric flange unions.

D. Solder. 95-tin, 5-antimony solder per ANSI B16.18.

E. Soldering Flux. Paste type.

2.10 STAINLESS STEEL TUBING

A. Tubing. ASTM A269, Grade TP304.

B. Compression Fittings. ASTM A269, Grade TP316, Parker "CPI" or "Intru-Lok", Crawford "Swage-Lok", or approved substitution.

PART 3 - E X E C U T I O N

3.1 PIPE INSTALLATION

A. Handling. Handle pipe, fittings and accessories to ensure their installation in a sound, undamaged condition. Use equipment, tools and methods to prevent damage in unloading, hauling and laying pipe and fittings. When using hooks in pipe ends, be sure that the contact surfaces are broad and well padded. Take particular care not to damage pipe coating or lining.

B. Cutting. Cut pipe in a neat manner, without damage to the pipe or to the interior lining, if any. Make cuts smooth, straight, and at right angles to the pipe axis. Use mechanical pipe cutters of an approved type.

C. Cleaning and Inspection. Thoroughly clean the interior of pipe and fittings of foreign matter before installation and keep the interior clean until the work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in the pipe. Before installation, inspect

each pipe and fitting for defects. Tap the pipe with a light hammer to detect cracks. Defective, damaged or unsound pipe and fittings shall be rejected and removed from the site.

D. Bends. Only long radius elbows shall be permitted for process piping. Where space constraints prohibit the use of long radius elbows, contractor shall submit shop drawings of proposed short radius fitting and indicate on drawings where short radius fittings are to be installed.

3.2 JOINTS AND JOINTING

A. Screwed Joints. Thoroughly ream the pipe to full inside diameter after cutting. Machine cut threads to ANSI taper pipe thread sizes. All-thread nipples are not permitted. Make screwed joints using suitable joint compound applied to male threads only; for screwed joints on PVC pipe, use Teflon tape.

B. Solvent-Weld Joints. Make solvent welded joints on PVC pipe in strict accordance with the manufacturer's instructions as to preparation, solvent and jointing.

C. Push-on Joints. Follow instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations. Lubricate joint surfaces with heavy vegetable soap solution immediately before joint is completed. Suitably bevel each spigot end to facilitate assembly.

D. Welded Joints.

1. Make welded joints as recommended by Standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. The filler metal must be suitable for use with the base metal. The inside of fittings and joints must be free from globules of weld metal which would restrict the flow or become loose. Do not use mitered joints.
2. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
3. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
4. Remove dirt, scale and other foreign matter from inside piping before typing in sections, fittings valves or equipment.

E. Mechanical Joints. Mechanical joint pipe may be used where indicated on the plans.

F. Flanged Joints.

1. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe and equipment. Align bolt holes to straddle the vertical, horizontal or north-south center line. Do not exceed 3/64-inch per foot inclination of the flange face from true alignment.
2. Use full-face neoprene or Buna-N gaskets, 1/8-inch thick, for flanged joints in ductile iron, steel or PVC piping. Gaskets shall be factory cut to proper seating of gaskets.
3. Use ANSI nuts and bolts, galvanized or black to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
4. Take care when attaching suction and discharge piping to pumping equipment to ensure that no stresses are transmitted to or imposed on pump suction and discharge flanges by connected piping. Install and permanently support piping to accurately match bolt holes and to provide uniform contact over the entire flange. In addition, leave pump connection piping free to move parallel to its longitudinal center line while bolts in pump connection flanges are tightened.
5. Provide maximum flexibility and ease of alignment correction by taking advantage of the slack between the flange bolts and bolt holes for slight angular rotation of connecting flanges. Assemble pump

connecting piping with gaskets in place, with only a portion of the flange bolts (no fewer than 4 per joint) installed. After final alignment and before final bolting, test pump connections for applied piping stresses by loosening flange bolts which, if piping is properly installed, should result in no movement of piping relative to the pump, or opening of the pump connection joints.

6. Keep flange covers on equipment and shop-fabricated piping until ready to install in system.

G. Grooved Joints. Prepare pipe ends and install grooved-end couplings in accordance with manufacturer's instructions.

3.3 SECURING AND SUPPORTING

A. Pipe Supports. Support piping in accordance with Section 15094, Supports and Hangers and as shown on the drawings and as specified herein, to maintain line and grade and prevent the transfer of stress to pumps or other equipment. All such supports and fasteners shall be hot-dip galvanized.

B. Reaction Anchorage and Blocking. Install suitable reaction blocking, struts, anchors, clamps, joint harness or other adequate means for preventing movement of pipe caused by unbalanced internal liquid pressure. Pressure can be expected at un-lugged tees, Y-branches and bends deflecting 11-1/4 degrees or more which are installed in piping subjected to internal hydrostatic heads in excess of 15 feet in exposed piping.

3.4 PIPE SLEEVES

A. Provide pipe sleeves for all piping passing through masonry or concrete construction, unless detailed otherwise on the drawings. Pipe sleeves shall be fabricated from steel and shall be hot-dip galvanized after fabrication. Pipe sleeves shall be sized to allow 1/2- to 1-inch clearance between pipe and sleeve.

B. Extend each pipe sleeve through the floor or wall. Finish flush with each surface, except that for exposed slabs, extend pipe sleeves 2 inches above finished slab elevations.

C. Seal annular space between pipes and sleeves with mastic compound, unless shown otherwise on the drawings. All pipes passing through pipe sleeves must have annular space sealed watertight and airtight.

3.5 BURIED PIPE INSTALLATION

A. Preparation.

1. Use piping and materials for service types specified.
2. Before installation, inspect pipe for defects and tap with a light hammer to detect cracks. Replace sections of pipe found to be defective, damaged or unsound, before or after laying.
3. Do not lay pipe in water, or when trench or weather are unsuitable for work. Keep water out of trench until jointing is complete. When work is not in progress, close ends of pipe and fittings securely so that no trench water, earth or other substance will enter pipes or fittings.
4. Keep the inside of the pipe free from foreign matter during operations by plugging or other approved method.
5. Place pipe so that the full length of each section rests solidly upon the pipe bed, with recesses excavated to accommodate bells and joints. Take up and re-lay pipe when the grade or joint is disturbed after placement.
6. Where pipe ends are left for future connections, install valves, plugs or caps, as shown.
7. Handle pipe and accessories so that all pipe placed in the trench is sound and undamaged. Take particular care not to injure pipe coatings. Do not place other pipe or anything else inside of pipe or fitting after coating has been applied.
8. Cut neatly, using approved type mechanical cutter without damaging pipe. Use wheel cutters when practical.

B. Pipe Bedding and Backfill. All pipe bedding shall be Class A unless otherwise specified.

C. Placing and Laying.

1. Do not exceed pipe manufacturer's recommendations for deflections from straight line or grade as required by vertical curves, horizontal curves, or offsets. If alignment requires deflections in excess of these limitations, furnish special beds or sufficient number of shorter lengths of pipe to provide angular deflections within the limits set or approved.
2. Immediately before installation in the trench, the pipe and appurtenances shall be carefully examined for damage and defects. Defective materials shall be marked and held for inspection by Owner's Inspector who may order corrective repairs or reject those materials. Repairs and replacement shall be made at no additional cost to the Owner. Carefully lower the pipe and appurtenances into the trench so as to avoid damage to them or their coatings. The joints shall be assembled, and the pipe brought to correct line and grade. Embedment and backfill materials shall be placed and compacted as previously described to hold it in place before testing. The polyethylene sleeves shall be installed around the pipe as recommended by the manufacturer.

D. Joints.

1. Assemble mechanical joints according to the recommendations of the manufacturer.
2. Make slip-on joints according to the recommendations of the manufacturer.

E. Anchorage of Fittings. Thrust blocking shall in accordance with applicable standard details and specifications.

F. Non-Metallic Pipe (HDPE, PVC, FRP). An electrically continuous corrosion-resistant tracer wire (min AWG 14) or detectable metallic underground tape shall be buried with the plastic pipe to facilitate locating. One end shall be brought aboveground at a building wall or riser to indicate installation.

G. Identification of Force Main Pipes. Per the requirements of 30 TAC § 217.66 a detectable underground warning tape must be laid in the same trench as a force main pipe (pressurized RAW). This tape must be located above and parallel to the force main. The detectable underground warning tape must bear the label "PRESSURIZED WASTEWATER" continuously repeated in at least 1.5-inch-tall letters.

3.6 CLEANING PIPING SYSTEMS

All piping systems must be thoroughly cleaned and flushed, and all construction debris of foreign material removed. The Contractor shall provide all temporary connections and equipment required to facilitate required cleaning.

3.7 POTABLE WATER PIPE STERILIZATION

A. Chlorination. Sterilize all potable water system piping with solution containing not less than 10 parts per million chlorine, prior to final inspection and acceptance for domestic operation. Flush lines thoroughly before introducing chlorinating materials. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million. Open and close valves in lines being sterilized several times during contact period.

B. Bacteriological Tests. After sterilizing and flushing potable water lines, obtain the services of an approved laboratory to gather representative samples and conduct bacteriological tests. Test results must meet Texas Department of Health requirements. Make all necessary corrections, repeat sterilization and flushing procedures, and retest affected lines, if test results are not acceptable. Repeat this procedure until satisfactory results are obtained.

C. Re-sterilization. Should any of the Contractor's activities during construction operations or during repair of defective materials, workmanship, and the like result in possible contamination of previously sterilized portions of the potable water system, the affected portion shall be cleaned, re-sterilized and bacteriological tests again conducted, all at no additional cost to the Owner.

3.8 TESTING

A. Pressure Piping Systems. Prior to the completion of backfill, and while joints and fittings are still exposed, test new pressure lines hydrostatically. Conduct hydrostatic tests in the presence of the Owner's Inspector and in an approved manner. Apply test pressure equal to normal static line pressure plus 60 psi and maintain this pressure for a minimum of 2 hours. Do not permit line losses during the test to exceed 50 U.S. gallons per inch of pipe diameter per mile per day. Regardless of the rate of line loss, repair observed leaks. Replace faulty or defective materials at no change in the contract sum. Provide all pumps, gauges, meters and other equipment necessary for performance of the tests.

B. Leakage Testing of Gravity Piping Systems. After a gravity sewer or non-pressurized pipe section including wyes, tees, and all appurtenances has been laid and backfilled, but prior to placement of pavement or overlaying structure, the Contractor shall test the pipe for leakage by either the Low-Pressure Air Test or Exfiltration Test. The Owner's Inspector shall be present at the time of testing. If the test results indicate an unacceptable installation, the Contractor shall locate the source of leakage, correct the defect, and retest until the installation is proven satisfactory.

3.9 PAINTING

All exposed metal piping surfaces shall be appropriately coated in accordance with the requirements of Section 09828, Protective Coatings for Wastewater Systems.

END OF SECTION

SECTION 15075

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Access Tile Identification.
8. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, manufacturer's catalog data, including size, color and materials.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with ASME A 13.1 "Scheme for the Identification of Piping Systems."

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inchthick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

1. NPS 5 (DN 125) and smaller: Attach to pipe without fasteners or adhesive.
2. NPS 6 (DN 150) and larger: Attach to pipe with stainless steel spring fasteners.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

D. Maximum Temperature: Able to withstand temperatures up to 180 deg F (83 deg C).

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for ductwork; minimum letter height of 1-1/2 inches for ducts.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, acrylic enamel unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 ACCESS TILE IDENTIFICATION

A. Buttons, tabs, and markers: To identify location of concealed work.

B. Type: As approved by Architect.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feetin areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Refrigerant Piping:

a. Background Color: White.
b. Letter Color: Yellow.

2. Vent and Relief Piping:

a. Background Color: White.
b. Letter Color: Black.

3. City Water Piping:

a. Background Color: White.
b. Letter Color: Yellow.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. All systems: 1-1/2 inchesround.

2. Valve-Tag Color:

a. All systems: Natural.

3. Letter Color:

    a. All systems: Black.

3.5 ACCESS TILE IDENTIFICATION

A. Install buttons, tabs, or markers, where removable ceiling tiles are provided, to identify location of:

1. Valves.
2. Volume dampers.
3. Terminal Units.
4. Other concealed equipment requiring access.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 15080

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, Division 15 Specification Sections, and Common Work Requirements for HVAC apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Refrigerant suction and hot-gas piping, indoors and outdoors.

1.3 SUBMITTALS

A. Action Submittals:
1. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
2. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   b. Detail attachment and covering of heat tracing inside insulation.
   c. Detail insulation application at pipe expansion joints for each type of insulation.
   d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   e. Detail removable insulation at piping specialties.
   f. Detail application of field-applied jackets.
   g. Detail application at linkages of control devices.

B. Informational Submittals
1. Qualification Data: For qualified Installer.
2. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
3. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15060 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation shall comply with ASHRAE/IESNA 90.1, all applicable codes and requirements of the Authority having jurisdiction.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Calcium Silicate:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Industrial Insulation Group (IIG); Thermo-12 Gold.

2. Thermal Conductivity (k-value) at 300°F mean temperature is 0.40 Btu x in./hr. x ft. x degree F. or less.
3. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
5. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

H. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Pittsburgh Corning Corporation; Foamglas.

2. Thermal Conductivity (k-value) at 75°F mean temperature is 0.27 Btu x in./hr. x ft. x degree F. or less.

3. Block Insulation: ASTM C 552, Type I.
4. Special-Shaped Insulation: ASTM C 552, Type III.
5. Board Insulation: ASTM C 552, Type IV.
6. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
7. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
8. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

I. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Aeroflex USA, Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2. Thermal Conductivity (k-value) at 75°F mean temperature is 0.245 Btu x in./hr. x ft. x degree F. or less. Water absorption not be more than 0.2% by volume.

J. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type [I] III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Johns Manville; Microlite.
   b. Knauf Insulation; Friendly Feel Duct Wrap.
   c. Owens Corning; SOFTR All-Service Duct Wrap.

2. Thermal Conductivity (k-value) at 75°F mean temperature is 0.29 Btu x in./hr. x ft. x degree F. or less.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000-Degree Pipe Insulation.
   c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Thermal Conductivity (k-value) at 75°F mean temperature is 0.23 Btu x in./hr. x ft. x degree F. or less.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with

ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 75 deg F is 0.27 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Johns Manville; MicroFlex.
    b. Knauf Insulation; Pipe and Tank Insulation.
    c. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
    b. Eagle Bridges - Marathon Industries; 290.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
    d. Mon-Eco Industries, Inc.; 22-30.

e. Vimasco Corporation; 760.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

4. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
5. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

4. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
    b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.

F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Dow Corning Corporation; 739, Dow Silicone.
    b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.

d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    b. Eagle Bridges - Marathon Industries; 570.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    b. Eagle Bridges - Marathon Industries; 550.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    d. Mon-Eco Industries, Inc.; 55-50.
    e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.

4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    b. Marathon Industries; 405.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    b. Eagle Bridges - Marathon Industries; 405.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
      2) ITW Insulation Systems.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
2) ITW Insulation Systems.

7. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Polyguard Products, Inc.; Alumaguard 60.

E. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film.
b. ITW Insulation Systems.

F. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
b. ITW Insulation Systems.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
e. .

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
e. .

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
   b. ITW Insulation Systems.

2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

b. ITW Insulation Systems.

2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 3/4 inch wide with closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.
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. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches] [4 inches] o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor

insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches

over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

E. Insulation Installation on Pipe Riser Clamps:

1. Install pre insulated riser clamp (similar to Pipe Shields) insulation between pipe and clamp as per the manufacturer recommendations.
2. Provide Cellular Glass insulation on cold pipes and Cellular Glass or Calcium Silicate insulation on hot pipes.
3. Make width of insulation section same as overall width of clamp shield.
4. Ensure that no voids are present between inner circumference of clamp shield insulation and outer circumference of adjacent straight insulated pipe segments.
5. Minimum insulation R value shall comply with the pipe insulation requirement.
6. Provide inner Thrust plates with heat trace grove where pipes are provided with heat tracing. The number of heat trace groves and location shall be coordinated with the design drawings.

3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.11 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect or Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 INDOOR PIPING INSULATION SCHEDULE

A. Thickness shall be as follows:

Minimum Pipe Insulation Thickness	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
	Conductivity Btu-in./(h ft^2 ^{o}F)	Mean Rating Temp ^{o}F	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
Cooling Systems (Refrigerant)							
40-60	0.21 – 0.27	75	1.0	1.0	1.5	1.5	1.5
<40	0.20 – 0.26	75	1.0	1.0	1.5	1.5	1.5

B. Any deviation from the specified insulation conductivity, the contractor shall submit calculations showing required insulation thickness for approval. It will be contractor's responsibility to coordinate increase in insulation thickness with all trades.

C. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I

D. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I

E. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric

3.15 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. The minimum insulation thickness shall have an additional one (1) inch thickness for the refrigerant piping as specified for the Indoor Piping insulation.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric
b. Mineral-Fiber, Preformed Pipe Insulation, Type I

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed, located in the Penthouse mechanical room or Boiler room, located within 10 feet of the finished floor:

1. None.
2. PVC: 30 mils thick.

3.17 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:

1. Self-Adhesive Outdoor Jacket, 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation.

END OF SECTION

SECTION 15094

SUPPORTS AND HANGERS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of all labor, materials, equipment, tools and related items required to furnish and install all pipe hangers, brackets, saddles, clamps and pipe rolls for all types of piping systems. Pipe hangers and supports shall be furnished complete with all necessary inserts, bolts, nuts, threaded rods, washers and other accessories.

B. In certain locations, pipe supports, anchors and expansion joints have been shown on the drawings, but no attempt has been made to indicate every pipe support, anchor and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with this section. Additional pipe supports may be required adjacent to expansion joints or couplings.

C. Concrete and fabricated steel supports shall be as indicated on the drawings, as specified in other sections, or in the absence of such requirements, as approved by the Engineer.

D. All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.

E. Pipe supports and expansion joints are not required in buried piping but concrete blocking or other suitable anchorage shall be provided.

1.2 REFERENCE STANDARDS

A. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) SP-58 - Pipe Hangers and Supports, Materials Design and Manufacture, latest edition.

B. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) SP-69 - Pipe Hangers and Supports, Selection and Application, latest edition.

1.3 SUBMITTALS

A. Provide submittals in conformance with the requirements of Section 01300, Submittals.

B. Include the maximum load carrying capacity of the support and the support system arrangement.

PART 2 - P R O D U C T S

2.1 ACCEPTABLE MANUFACTURERS

Pipe supports shall be manufactured by a company regularly engaged in the production of pipe supports such as Anvil, Elcen, Fee and Mason, Grinnel or approved substitution.

2.2 MATERIALS

A. Design and Construction. Pipe hangers and supports shall be designed and constructed to meet the requirements of MSS SP-58 and SP-69.

B. All hangers, brackets and clamps shall be standard weight steel. Do not use perforated strap hangers. When two or more pipes are run parallel, they may be supported on trapeze hangers.

C. Unless otherwise shown on the drawings, all horizontal runs of piping suspended from the walkways or roof construction, as the case may be, shall be suspended by means of approved hangers.

D. All individually suspended horizontal pipes in the building shall be supported by steel rods sized as follows:

Pipe Size (in inches)	Rod Size (in inches)
2 and smaller	3/8
2-1/2 - 3-1/2	1/2
4 - 5	5/8

E. Continuous slotted inserts may be used to support multiple lines running in close proximity on either individual hangers or on trapeze. Use expansion shields with bolts and horizontal drilled holes in existing concrete construction to support new piping.

F. Hangers supporting 4 inches and larger ferrous pipe shall be with two nuts for each support.

G. All vertical risers shall be supported by riser clamps or supports at each floor and every eight feet. Install 4-inch-square plate on masonry with attached rod using hangers fastened to risers.

H. Where anchors are used on copper piping, use copper plate U-bolts and chairs.

I. For horizontal piping along equipment room walls, use brackets with hangers and rods as specified unless otherwise shown on the drawings.

J. Install supports and hangers to permit free expansion and contraction in the piping system. Where necessary to control expansion and contraction, piping shall be guided and firmly anchored. Anchors shall be approved by the Engineer. Design for equal effectiveness for both longitudinal and transverse thrust. No piping shall be self-supporting, nor shall it be supported from equipment connections. Transmission of vibration, noise, etc., shall be considered, and any special suspension with vibration dampers to minimize transmission shall be used where necessary. Shooting of anchors into concrete will not be allowed.

K. Where ducts interfere with the proper location of hangers, furnish and install trapeze hangers.

2.3 TYPE

Pipe hangers and supports shall be selected from one of the types shown on Figure 1 of MSS SP-58 and MSS SP-69.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Pipe Support Spacing. The maximum spacing of hangers and supports shall be as shown in Table 3 of MSS SP-69.

B. Application.

1. Support piping approximately 1-1/2 inches out from the face of walls and at least 3 inches below ceilings.

2. Concrete inserts or L-shaped anchor bolts shall be used to support piping from new cast-in-place concrete. Expansion anchors shall be used to fasten supports to existing concrete and masonry.
3. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.
4. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Threaded rods shall be of sufficient threading to permit the maximum adjustment available in the support item.
5. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur to expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellows type expansion joints may be located adjacent to the joint.
6. Pipe guides shall be provided adjacent to bellows type expansion joints. Guides will not be required when mechanical couplings are permitted as expansion joints. Guides shall be placed on both sides of expansion joints except where anchors are adjacent to the joints. Unless otherwise indicated on the drawings, one guide shall be within four pipe diameters from the joint and a second guide with 14 pipe diameters from the first guide. Pipe supports shall allow adequate movement; pipe guides shall not be used for support. Pipe guides shall be installed as recommended by the manufacturer.

C. Adjustment. All hangers shall be adjustable. Wall hangers shall have slotted bolt holes. Ceiling hangers shall have turnbuckles. Floor supports shall have extended anchor bolts such that the support can be wedged to proper elevation and grouted. Provide a minimum of one inch of grout.

D. Pipe Rack. Pipe supported on pipe rack shall be supported on channels manufactured by Unistruct, Powerstrut or approved substitution. Clamp pipes on the channel support by pipe clamps of the same manufacturer.

E. The manufacturer shall confirm the structures, to which supports and hangers are attached, can sustain the full load of the pipe and fluid plus the dynamic loads.

3.2 INSULATED PIPE

Insulated pipe shall have protective saddles where supported. Insulation shall pass through the supports. Size supports for the full outside diameter of the insulation.

3.3 PLASTIC OR FIBERGLASS PIPE

Plastic or fiberglass pipe shall have cradles to distribute the load over a length of at least six inches at all supports.

END OF SECTION

SECTION 15104

PIPE AND PIPE FITTINGS - GENERAL

PART 1 - G E N E R A L

1.1 SUMMARY

Requirements for pipe and pipe fittings for all sections of Division 15 - Mechanical which employ pipe and pipe fittings.

1.2 QUALITY ASSURANCE

A. Employ welders certified in accordance with applicable portions of Section IX, ASME Boiler and Vessel Code, or ASA Code for Pressure Piping.

A. Employ welders qualified to perform welding operations required either by certifications or by submitting to required tests.

B. Welds shall be wire brushed after completion, coated with rust inhibitor paint and, on galvanized pipes, given two coats of cold-applied galvanizing compound and one coat of aluminum paint.

1.3 SUBMITTALS

Submit manufacturer's product data showing compliance with requirements of Part 2.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

Acceptable manufacturers are specified with individual component type where applicable for this section.

2.2 PIPE AND FITTINGS

The particular type of pipe and fittings for each system is specified in the section on that system.

2.3 JOINTS

A. Screwed. Make screwed joints using machine-cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.

B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using dielectric insulating unions such as Crane Company No. 1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved substitution.

C. Solder Joints.

1. Prior to making joints, cut pipe square and ream to full diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.

3. Use silver brazing alloy or Sil-Fos on refrigerant piping and on underground piping. Use 95.5 solder on all other non-potable water piping. For potable water piping, use lead-free solder.
4. Joints in copper drainage tube shall be soldered using acceptable fittings. Surface to be soldered shall be cleaned bright. The joints shall be properly fluxed and made with solder. Joints shall be made with 50-50 tin-lead, 95-5 tin-antimony solder, Stay-Brite Solder by J. W. Harris Company, Inc., or cadmium-free brazing.

D. Welded. Welded joints shall be welded as set forth in the Standard Manual of Pipe Welding of the Heating, Piping and Air Conditioning Contractors Association. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. Do not use mitered joints.

E. Flanged.

1. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64 inch per foot inclination of the flange face from true alignment.
2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.
3. Install proper gaskets, suitable for intended service and factory cut to proper dimensions. Secure with a suitable gasket cement.
4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground outdoors or in wet locations. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
5. Use carbon steel flanges conforming to ANSI B16.5 with materials conforming to ASTM A 105, Grade II or ASTM A 108, Grade II. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
6. Keep flange covers on equipment and shop-fabricated piping until ready to install in system.

F. No Hub. Joints in cast iron soil pipe and fittings without hubs shall be made using a mechanical compression-type coupling consisting of a neoprene collar, stainless steel band with transverse corrugations and two corrosion-resisting steel clamps with corrosion-resisting steel set screws, all assembled to provide seal. Install according to manufacturer's recommendations, using recommended tools.

G. Mechanical Joints. Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following or approved substitution.

1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
2. U.S. Joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
4. Flexklamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.

H. Compression Joints for Cast Iron Water Pipe. Use Beltite, Tyton or Grip-Tite compression joints. Install in accordance with the manufacturer's recommendations and with ASTM C 443. Use only with pipe and fittings designed for compression gaskets. Provide adequate concrete thrust blocks at changes of direction, as recommended by manufacturer.

I. Bell and Spigot. Pack joint with dry oakum. Run the joint full with molten lead in one continuous pour. Use not less than 12 ounces of lead for each inch of pipe diameter. At Contractor's option, use double seal, neoprene compression joints.

J. Ring-Tite Joints. Furnish joints for installation according to manufacturer's recommendations. Provide adequate concrete thrust blocks at changes in direction, as recommended by manufacturer.

K. Plastic.

1. With Schedule 80 or heavier, use threaded joints. Provide sharp, clean pipe dies and Teflon thread tape. Make joints in strict accordance with manufacturer's recommendation.
2. With Schedule 40 or lighter, use solvent cement method in strict accordance with manufacturer's recommendations.
3. Joints in ABS or PVC DWV plastic pipe shall be made with fittings either solvent welded or fusion welded connections, insert fitting and metal clamps and screw of corrosion-resistant material, or threaded joints according to accepted standards.

L. Victaulic Joints. Make joint with Victaulic Style 77 coupling fitted with a molded synthetic rubber gasket per ASTM D 2000. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation. Groove pipe to manufacturer's specifications.

M. Ball Joints. Where shown, provide flexible ball joints, made of carbon steel. Ball joints must have 15 degrees of angular flexibility. Use welded or flanged ends, as required. Furnish with 11N gaskets.

2.4 BRANCH CONNECTIONS

A. For Pipe 2 Inches and Smaller. For threaded piping, use straight reducing tee. When branch is smaller than header, a nipple and reducing coupling or swaged nipple may be used.

B. For 2-1/2 Inches Through 36 Inches. For welding piping, when branch size is the same as header size, use welding tee. Use Weldolet when branch is smaller than header. For threaded branch connections, use 3000-pound full coupling welded to header.

2.5 GASKETS

A. High Temperature Piping. Provide 1/16-inch-thick ring Graph-Lock gaskets of flexible graphite with 316 stainless steel Tanged core in the center, such as Garlock No. 3125TC or approved substitution.

B. Other Piping (Chilled, Hot and Domestic Water Only). Provide 1/16-inch-thick ring gaskets of synthetic fiber, Garlock Style 3400 or approved substitution.

2.6 FLOOR AND CEILING PLATES

Provide escutcheons on all exposed pipes passing through floors, walls, floors and ceiling. Material shall be chrome-plated steel. Flange size shall be as necessary to cover penetrating openings. Plate size shall be as necessary to fit pipe or insulation and securely lock in place. Manufacturer/model shall be by Engineered Brass Company, Type CF, or approved substitution.

2.7 PIPE SUPPORTS

Provide standard Unistrut metal framing members and appurtenances for pipe support where shown. Multi-A-Frame and Power-Strut pipe support systems also are acceptable. Hot-dip galvanize all such members and appurtenances.

2.8 PIPE SLEEVES

Sleeves below grades in outside walls are detailed on drawings. Provide Thunderline Link-Seal with cadmium-plated nuts and bolts, with cast iron pressure plate.

2.9 PIPE GUIDES

Provide ADSCO Model H pipe alignment guides for uninsulated pipe or for insulated hot lines. Provide RS or RC spider as indicated or required. Use ADSCO Model E1 for cold insulated lines. Provide ADSCO or approved substitution.

2.10 FIRESTOPPING

Voids between sleeves or core-drilled holes and pipe passing through fire rated assemblies shall be firestopped to meet the requirements of ASTM E 814, in accordance with Section 07840, Firestopping. Contractors shall provide proper sizing when providing sleeves or core-drilled holes to accommodate their through-penetrating items.

PART 3 - E X E C U T I O N

3.1 PREPARATION

A. Ream pipe and tube ends to remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

3.2 PIPE FABRICATION AND INSTALLATION

A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the maximum access to various equipment parts for maintenance.

B. Do not cut or weaken any structural member.

C. Cut all pipes accurately to measurement determined at the site. After cutting pipe, ream it to remove burrs.

D. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make all changes in direction. Field bending and mitering are prohibited. Make all connections to equipment using flanged joints or unions. Make reducing connections with reducing fittings only.

3.3 WELDING

A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping by using a metallic arc welding process. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards. Conform to the current recommendations of the American Welding Society for all welding operations.

B. Align piping, fittings and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

C. Do not permit any weld to project within the pipe in excess of 1/16 inch so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.

D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

E. Remove dirt, scale and other foreign matter from inside piping before tying in sections, fittings, valves or equipment.

F. Nondestructive examination of welds will be conducted at Owner's direction using radiography. Acceptable welds will not display any imperfections as indicated in Table 136.41 of Power Piping Code B31.1-1986.

3.4 OFFSETS AND FITTINGS

A. Because of the small scale of drawings, the indication of all offsets and fittings is not possible. Carefully investigate the structural and finish conditions affecting the work and take such steps as may be required to meet such conditions.

B. Install all piping close to walls, ceilings and columns so piping will occupy the minimum space. Provide proper space for covering and removal of pipe, special clearances, and for offsets and fittings.

3.5 SECURING AND SUPPORTING

A. Support piping adequately to maintain line and grade, with due provision for expansion and contraction. Use hangers as scheduled below, properly connected to structural members of the building. All hangers and supports shall be in accordance with the American Standard Code for Pressure Piping, ANSI B-31.

Pipe Size	Hanger Type
1/2″ to 1-1/2″	Adjustable Swivel Split Ring (Malleable Iron)
2″ to 4″ and Cold Pipe Sizes 6″ and Larger	Carbon Steel Adjustable Clevis
Hot Pipe Sizes 6″ and Larger	Adjustable Steel Yoke, Cast Iron Roll, Double Hanger
Multiple or Trapeze Hangers	Steel Channels with Welded Spacers and Hanger Rods; Cast Iron Roll and Stand for Hot Pipe Sizes 6 Inches and Larger

B. Use copper hangers with copper pipe. As an alternate, tape copper pipe at all points contacting steel hangers, structural members or sleeves. Use a dual wrap of polyvinyl tape.

C. Place hangers not more than 6 feet apart on 1/2-inch to 1-1/4-inch pipes, 10 feet apart on 1-1/2-inch to 6-inch pipes, and 14 feet on larger pipes. Place hangers not more than 6 feet apart for all sizes of polyvinyl chloride pipe, not more than 5 feet on bell-and-spigot (adjacent to each joint), and not more than 4 feet apart on no-hub piping (adjacent to each joint). Place a hanger within 12 inches of each horizontal elbow.

D. Support vertical risers with steel strap pipe clamps of approved design and size, properly supported at every floor. Support piping assemblies in chases adequately enough to be rigid and self-supporting before the chase is closed. Provide adequate structural support for piping penetrating chase walls to fixtures.

E. Support piping from walls with welded steel bracket and wrought steel clamp. For hot pipes, furnish adjustable steel yoke and cast-iron rollers.

F. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section.

G. Perforated bar hangers, straps, wires or chains are not permitted. Plastic support brackets as manufactured by P & M Company may be used in accordance with the manufacturer's recommendations.

H. Hanger rods shall be carbon steel with galvanized finish, sizes per the following schedule:

Pipe Size	Rod Size
≤ 2″	3/8″
2″ < 3″	1/2″
4″	5/8″

I. Licensed Engineer's Report. Submit a hanger and support installation report for piping diameters of 5 inches and larger. Include seal and signature of Registered Engineer, licensed in Texas.

J. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints and loops.

K. Install hangers and supports so that piping live and dead loading stresses from movement will not be transmitted to connected equipment.

3.6 ANCHORS

Provide anchors as indicated or required. All anchors shall be in accordance with the American Standard Code for Pressure Piping, ANSI B-31. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe.

3.7 PIPE SLEEVES

A. Fit all pipes passing through masonry and concrete construction above grade with sleeves of 20- or 22-gauge galvanized steel pipe. Size sleeve for minimum clearance between pipe or insulation and sleeve. Use galvanized or black steel pipe for passing through fire-rated enclosures.

B. Extend each sleeve through the floor or wall. Cut the sleeve flush with each surface, except that in exposed locations, extend floor sleeves 3 inches above finished floor line.

C. Caulk all sleeves water and airtight. Seal annular space between pipes and sleeves with firestopping compound.

3.8 PIPE GUIDES

A. Guide expansion joints with two guides on the side opposite the anchor.

B. Guide pipe installed and supported by Unistrut supports using a duplicate set of pipe rolls on the top of the pipe.

C. Guide piping in vertical chases at a maximum guide spacing of 15 feet.

D. All guides shall be in accordance with the American Standard Code for Pressure Piping, ANSI B-31.

3.9 ISOLATION VALVES

Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for all equipment, and at other locations as indicated and required.

3.10 DRAIN VALVES

Install drain valves at all low points of water piping systems so that these systems can be entirely drained. Install a 2-inch drain for 2-inch pipes and larger. Install a line size drain valve for pipes smaller than 2 inches.

3.11 CLEANING OF PIPING SYSTEMS

A. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the systems in service. Provide whatever temporary connections are required for cleaning, purging and circulating.

B. Install temporary strainers in front of pumps, tanks, water still, solenoid valves, control valves, and other equipment where permanent strainers are not indicated. Keep these strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blowoff valve.

C. Circulate a chemical cleaner in chilled, heating and condensing water as well as steam and condensate piping systems to remove mill scale, grease, oil and silt. Circulate Betz Entec 323 detergent with Betz Entec 234 anti-foam compound. Circulate for 48 hours, flush system and replace with clean water. Dispose of chemical solution in accordance with local codes. The chilled and heating water system should then be treated with Betz Entec 338, nitride borate, 350 ppm as nitride with MBP inhibitor.

D. Special cleaning requirements, if any, are specified in the sections on each type of piping.

3.12 COATING AND WRAPPING

Double wrap underground steel piping with two spiral wrappings of fiberglass wrapper with three coats of coal-tar enamel applied before, between and after wrappings. Finish with a spiral wrap of 60-pound kraft paper wrapper.

3.13 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS

Provide service connections to items of kitchen and laboratory furniture and equipment furnished by others. Drawings for kitchen and laboratory equipment are included in bidding documents. Detailed shop drawings of equipment will be furnished indicating the exact number and location of rough-in points. Such final shop drawings may indicate adjustments in total number and exact location of rough-in points, and in equipment dimensions. Making adjustments to field conditions is considered a part of the work required.

A. Roughing-In. When roughing-in, extend service piping to various items of equipment. Temporarily terminate at proper points as indicated on detailed equipment shop drawings or as directed. Do not use contract drawings accompanying these specifications for rough-in locations but only for pipe sizing and general routing.

B. Final Connections. Kitchen equipment will include all special items such as supply fittings, sink strainers, tailpieces, gas regulators, steam traps, and strainers. Laboratory furniture will include all service fixtures such as valves and cocks, valve and cock bases, sinks, cup sinks, sink and trough plugs, tailpieces, traps, and similar or associate furniture apparatus, set in place. Provide all standard items such as pipe, fittings, adapters, insulation, and other plumbing materials required to connect from rough-in locations to service fixtures and associated apparatus, including necessary stop valves and P-traps.

C. Stop Valves. Provide stop valves for each service at rough-in locations, except for drains. Stop valve locations are subject to approval, and in all cases must be accessible from the same room in which the furniture or equipment is located.

D. Reagent Rack Manifolds. Horizontal pipe manifolds in open-type reagent racks will be provided as part of the furniture. Include pipe nipples, tees, end caps and related parts ready for connection of service piping. Make up joints hand-tight only. Disassemble manifolds and reassemble making permanent joints. Insulate steam manifolds and chilled water manifolds using 1-inch-thick insulation.

COLOR CODE SCHEDULE

Code	Piping System	Legend or Tag	Color	Color No. Fed. Std. No. 595
F1	Fire Mains	Fire	Red	11105
D1	Oxygen Liner	Oxygen	Orange	12246
D2	Sodium Hypochlorite	Sodium Hypochlorite	Yellow	13655
D3	Raw Polymer	Raw Polymer	Pink	11158
D4	Diluted Polymer	Polymer	Purple	17142
D5	Natural Gas	Gas	Yellow	13655
D6	Heating Water Supply	HWS	Pink	11158
D7	Heating Water Return	HWR	Pink	11158
D8	Domestic Hot Water Supply	DOM-HWS	Lt. Pink	11668
D9	Domestic Hot Water Return	DOM-HWR	Lt. Pink	11668
S1	Potable Water	Potable Water	Blue	15102
S2	Non-potable Water	Non-potable Water	White	17875
S3	Instrument Air	Instrument Air	Green	14187
S4	Plant Air	Plant Air	Dk. Green	14110
S5	Raw Sewage	Raw Sewage	Gray	16473
S6	Grit	Grit	Dk. Gray	16187
S7	Cyclone Return	Cyclone Return	Gray	16473
S8	Classifier Return	Classifier Return	Gray	16473
S9	Heavy Solids	Heavy Solids	Dk. Brown	10080
S10	Return Sludge	Return Sludge	Brown	10091
S11	Waste Sludge	Waste Sludge	Yellow-Brown	10266
S12	Scum	Scum	Lt. Brown	10324
S13	Chilled Water Supply	CWS	Blue-Green	14325
S14	Chilled Water Return	CWR	Blue-Green	14325
S15	Condensing Water Supply	COND-WS	Lt. Green	14533
S16	Condensing Water Return	COND-WR	Lt. Green	14533
S17	Deionized Water	DW	Lt. Blue	15526
S18	Vacuum	V	White	17875
S19	Sump Liner	Sump Return	Dk. Brown	10080
S20	Reseed Line	Reseed Line	Brown	10091

END OF SECTION

SECTION 15105

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:
   1. Condensate-drain piping.

B. Related Sections include the following:
   1. Division 15 Section "HVAC Piping Insulation".

C. Definitions
   1. PTFE: Polytetrafluoroethylene.
   2. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
   3. RTRP: Reinforced thermosetting resin (fiberglass) pipe.
   4. DWV: Drain-Waste-Vent piping system.

1.3 SUBMITTALS

A. Action Submittals
   1. Product Data: Submit manufacturer's standard technical product data indicating conformance to the stipulated reference specifications, construction materials, dimensions, construction details, and test and operating pressures. Submit manufacturer's product data on the following:
      a. Pipe materials.
      b. Unions and flanges, including gaskets, nuts, and bolts.
      c. Welding fittings.
      d. Sleeves and packings.
      e. Plastic pipe and fittings with solvent cement.
      f. RTRP and RTRF with adhesive.
      g. Pressure-seal fittings.
      h. Air control devices.
      i. Chemical treatment.

B. Delegated-Design Submittal:

   1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
   2. Locations of pipe anchors and alignment guides and expansion joints and loops.

3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

C. Shop Drawings: Provide piping layout drawings, drawn to a scale of not less than 1/4 inch to 1 ft. showing the proposed layout of piping system including valves, fittings, equipment, pumps, hangers, grading, high points, low points, drain points, guides, anchors, ball joints, and expansion devices. Piping below 3 inches show single line, all 3 inches and above show double line. Coordination Drawings: Show double line at 3/8 inch to 1 ft. Calculations required for stressed piping at anchors. Provide shop drawings for the following locations:
1. Refrigeration machines.
2. All floor plans and roof plans.

D. Schedules:

1. Submit schedule of pipe type and rating for each system.

E. Informational Submittals
1. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   a. Suspended ceiling components.
   b. Other building services.
   c. Structural members.
2. Qualification Data: For Installer.
3. Welding certificates.
4. Field quality-control reports.
5. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Provide piping conforming to the requirements of the following:

1. American Society of Mechanical Engineers (ASME):

   a. B16.1: Cast iron pipe flanges and flanged fittings Class 25, 125, 250, and 800.
   b. B16.4: Cast iron threaded fittings Classes 125 and 250.
   c. B16.3: Malleable iron threaded fittings.
   d. B16.5: Pipe flanges and flanged fittings.
   e. B16.9: Factory-made wrought steel buttwelding fittings.
   f. B16.1: Forged steel fittings, socket-welding and threaded.
   g. B16.18: Cast copper alloy solder joint pressure fittings.
   h. B16.22: Wrought copper and copper alloy solder joint pressure fittings.
   i. B16.39: Malleable iron threaded pipe unions Classes 150, 250, and 300.
   j. B31: Code for pressure piping.
   k. B31.1: Power piping.

2. Installation of piping shall conform to the requirements of ASME B31.1 "Power Piping."
3. American Society for Testing and Materials (ASTM):

    a. A 53: Standard specification for pipe, steel, black and hot-dipped, zinc-coated welded seamless.
    b. A 106: Standard specification for seamless carbon steel pipe for high-temperature service.
    c. A 126: Standard specification for gray iron castings for flanges, and pipe fittings.
    d. A 193/A 193M: Standard specification for alloy-steel and stainless-steel bolting materials for high-temperature service.
    e. A 194/A 194M: Standard specification for carbon and alloy steel nuts for bolts for high-pressure and high-temperature service.
    f. A 216/A 216M: Standard specification for steel castings, carbon, suitable for fusion welding for high-temperature service.
    g. A 276: Standard specification for stainless and heat-resisting steel bars and shapes.
    h. A 307: Standard specification for carbon steel bolts and studs, 60,000 psi tensile strength.
    i. B 88: Standard specification for seamless copper water tube.

B. Codes and Standards: Provide hydronic specialties conforming to the requirements of the following:

1. Published specifications' standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this section.
2. Comply with all applicable national, state, and local codes and refer to Section "General Provisions" for mechanical for additional Reference Standards.
3. In addition, comply with all standards or associations as specified herein including, but not limited to, the following, as applicable:

    a. American Society for Mechanical Engineers (ASME).
    b. American Society for Testing and Materials (ASTM).
    c. American National Standards Institute (ANSI).

C. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

D. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

E. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Condensate-Drain Piping: 150 deg F.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L grooved piping.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Victaulic Company of America.

2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
3. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

E. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO Inc.
b. Viega LLC.

2. Housing: Copper.
3. O-Rings and Pipe Stops: EPDM.
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig working-pressure rating at 250 deg F.

F. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. These type of tees shall not be utilized on this project.

G. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Victaulic Company of America.
2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company of America.
   b. Viega LLC.
2. Housing: Steel.
3. O-Rings and Pipe Stop: EPDM.
4. Tools: Manufacturer's special tool.

5. Minimum 300-psig working-pressure rating at 230 deg F.

J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.

1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.

1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.5 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. 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.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

a. CPVC solvent cement shall have a VOC content of 490 g/L or less.
b. Adhesive primer shall have a VOC content of 550 g/L or less.

c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. PVC solvent cement shall have a VOC content of 510 g/L or less.
b. Adhesive primer shall have a VOC content of 550 g/L or less.
c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.6 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX USA LLC.
c. KBI (King Bros. Industries).
d. Viega LLC.

2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX USA LLC.
c. KBI (King Bros. Industries).
d. NIBCO INC.

2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Hart Industries International, Inc.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    e. Zurn Industries, LLC.

2. Description:

    a. Standard: ASSE 1079.
    b. Pressure Rating: 150 psig.
    c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    d. Zurn Industries, LLC.
    e.

2. Description:

    a. Standard: ASSE 1079.
    b. Factory-fabricated, bolted, companion-flange assembly.
    c. Pressure Rating: 150 psig.
    d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.
    e.

2. Description:

    a. Nonconducting materials for field assembly of companion flanges.
    b. Pressure Rating: 150 psig.
    c. Gasket: Neoprene or phenolic.
    d. Bolt Sleeves: Phenolic or polyethylene.
    e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elster Perfection Corporation.
    b. Grinnell Mechanical Products.
    c. Matco - Norca.
    d. Precision Plumbing Products, Inc.
    e. Victaulic Company.
    f.

2. Description:

    a. Standard: IAPMO PS 66.
    b. Electroplated steel nipple, complying with ASTM F 1545.
    c. Pressure Rating: 300 psig at 225 deg F.
    d. End Connections: Male threaded or grooved.
    e. Lining: Inert and noncorrosive, propylene.

2.8 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.9 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Under deck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.10 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Condensate-Drain Piping: Type L (TypeB) drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, ball valve, and short threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage. Ball valve and threaded nipple with cap: Up to 6 inches pipe use NPS 3/4

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Q. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

R. Install shutoff valve immediately upstream of each dielectric fitting.

S. Comply with requirements in Section 15075 "Identification for HVAC Piping and Equipment" for identifying piping.

T. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, pump, and elsewhere as indicated.

U. Install no piping in elevator machine rooms, electric rooms and closets, and telephone rooms and closets.

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 15060 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
7. Supports of wire, rope, wood, chain, strap, perforated bar or any other makeshift device will not be permitted.
8. Minimum spacing and minimum rod diameter shall comply with latest edition of MSS SP-58.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 9 feet.
5. NPS 2: Maximum span, 10 feet.
6. NPS 2-1/2: Maximum span, 11 feet.
7. NPS 3: Maximum span, 12 feet.
8. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.
9. NPS 6: Maximum span, 17 feet; minimum rod size, 3/4 inch.
10. NPS 8: Maximum span, 19 feet; minimum rod size, 3/4 inch.
11. NPS 10: Maximum span, 20 feet; minimum rod size, 7/8 inch.
12. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
13. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
14. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
15. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.

16. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, ½ inch.
7. NPS 3 : Maximum span, 10 feet; minimum rod size, ½ inch.
8. NPS 4: Maximum span, 12 feet; minimum rod size, ½ inch.
9. NPS 6: Maximum span, 14 feet; minimum rod size, 5/8 inch.
10. NPS 8: Maximum span, 16 feet; minimum rod size, 3/4 inch.
11. NPS 10: Maximum span, 18 feet; minimum rod size, 3/4 inch.
12. NPS 12: Maximum span, 19 feet; minimum rod size, 3/4 inch.

E. Plastic Piping Hanger Spacing: Space hanger according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

F. Fiberglass Piping Hanger Spacing: Space hanger according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Support vertical runs at roof, at each floor.

1. Base Elbow Support: Provide bearing plate on structural support, similar to F&S Manufacturing Corp. Fig. 720.
2. Provide guides at every third floor but not to exceed:

   a. 25 ft. for piping to 2 inches.
   b. 36 ft. for piping 2-1/2 inches to 12 inches.
   c. 50 ft. for piping 14 inches and larger.

3. Top Support: Provide special hanger or saddle in horizontal connection and make provisions for expansion.
4. Intermediate Supports: Steel pipe clamp at floor. Bolt and weld to pipe with extension ends bearing on structural steel or bearing plates.
5. For multiple pipes, coordinate guides bearing plates and accessory steel.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

1. Victaulic Training:
   a. The grooved coupling manufacturer’s (the “manufacturer”) factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. This shall be at the expense of the installing contractor.
2. Inspection:
   a. A manufacturer’s factory trained representative shall periodically visit the job site and review the installation for best practices. This shall be at the expense of the installing contractor. The installing Contractor shall correct any identified deficiencies.
   b. Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Inspection Services prior to the completion of the project. Any Victaulic product that has not been corrected or was not examined

will not be considered as part of the successful completion of Inspection Services.

3. Application:
   a. Upon completion of the manufacturer's inspection of the installation and any identified corrections, the manufacturer will provide the owner or purchaser with a limited warranty on manufacturer's products.

K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

END OF SECTION

SECTION 15106

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. This Section includes refrigerant piping, valves and refrigerant accessories used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

1.4 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.
7. Receivers.
8. Miscellaneous specialties and accessories

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and

pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Product Data: Catalog cuts giving general assembly of specialties and data including load capacity.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals, including assembly views, instructions for changing cartridges, and spare parts list.

1.5 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, dielectric unions, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASTM unless indicated otherwise.

C. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

D. Pressure Relief Valves: Install on ASME receivers. Discharge piped to outdoors.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed. Dehydrated and charge components such as piping and receivers, seal prior to shipment, and maintain seal until connected into system.

1.8 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations.

1.9 QUALIFICATIONS

A. Design piping system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the state where the Project is located.

1.10 MAINTENANCE MATERIALS

A. Provide two refrigeration oil test kits each containing everything required to conduct one test.

B. Provide two filter-dryer cartridges of each type.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L or ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8, BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 deg F.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; Type, Grade, and wall thickness as selected in Part 3 piping applications articles.

B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.

C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.

D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Flanged Unions:

1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Apply rust-resistant finish at factory.
2. Gasket: Fiber asbestos free.
3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
6. Pressure Rating: Factory test at minimum 400 psig.
7. Maximum Operating Temperature: 330 deg F.

F. Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
2. End Connections:

   a. NPS 2 and Smaller: With threaded-end connections.
   b. NPS 2-1/2 and Larger: With flanged-end connections.

3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.
8. With positive backseating.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem with backseating.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 300 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring or soldered.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel, copper, or brass.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded or soldered.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual Operator: Stem shall permit manual operation in case of coil failure.
9. Coil Assembly: UL listed, replaceable, with molded electromagnetic coil, moisture and fungus proof, with surge protector, color coded lead wired, and integral junction box with pilot light.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL. Factory sealed and stamped with ASME UV and National Board Certification NB, and ASHRAE 15.

1. Body and Bonnet: Ductile iron and steel or brass, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Internal or external equalizer.
3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Packing and Gaskets: Non-asbestos.
5. Capillary and Bulb: Copper tubing, replaceable type filled with refrigerant charge; remote sensing bulb.
6. Suction Temperature: 40 deg F.

7. Superheat: Adjustable.
8. Reverse-flow option (for heat-pump applications).
9. End Connections: Socket, flare, or threaded union.
10. Working Pressure Rating: 450 psig.
11. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 deg F superheat. Select valve to avoid being undersized at full load and excessively oversized at part load.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.

1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal.
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
8. End Connections: Socket.
9. Set Pressure: As required. .
10. Throttling Range: Maximum 5 psig.
11. Working Pressure Rating: 500 psig.
12. Maximum Operating Temperature: 240 deg F.

I. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

J. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

K. Moisture/Liquid Indicators: UL listed.

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm with removable element and plastic cap.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

L. Replaceable-Core Filter Dryers: Comply with ARI 730 and UL listed.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

M. Permanent Filter Dryers: Comply with ARI 730 and UL listed.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

N. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

O. Receivers: Comply with ARI 495 and UL listed. ASME tested and stamped if over 6" internal diameter.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

P. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

Q. Pressure Regulators:
   1. Body: Brass.
   2. Diaphragm: Stainless steel, direct acting.
   3. Adjustable over 0 to 80 psig range.
   4. Working Pressure Rating: 400 psig.
   5. Maximum Operating Temperature: 240 deg F.

2.4 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Atofina Chemicals, Inc.
   2. DuPont Company; Fluorochemicals Div.
   3. Honeywell, Inc.; Genetron Refrigerants.
   4. INEOS Fluor Americas LLC.

C. ASHRAE 34, R-22: Monochlorodifluoromethane.

D. ASHRAE 34, R-134a: Tetrafluoroethane.

E. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

F. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-22

A. Suction, hot-gas and liquid lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-134a

A. Suction, Hot-gas and Liquid Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper and wrought-copper fittings with brazed joints.

B. Safety-Relief-Valve Discharge Piping: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.3 PIPING APPLICATIONS FOR REFRIGERANT R-407C

A. Suction, Hot-Gas and Liquid Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

B. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.4 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction, Hot-Gas and Liquid Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.5 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at compressor inlet and outlet, at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Install check valves on condenser liquid lines on multiple condenser systems.

E. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

F. Install a full-sized, three-valve bypass around filter dryers.

G. Install Solenoid Valves as Follows:

1. Upstream from each expansion valve and hot gas by-pass valve.
2. In liquid line of systems operating with single pump-out or pump down compressor control.
3. In liquid line of single or multiple evaporator systems, including split circuit coils.
4. In oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
5. Install solenoid valves in horizontal lines with at top.

H. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

I. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

J. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

1. Use line size indicators in main liquid line leaving condenser and on leaving side of liquid solenoid valves.
2. If receiver is provided, install indicator in liquid line leaving receiver.

K. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.
5. On steel piping systems install strainer in suction line.
6. Install a shut-off valve on each side of strainers.

L. Install filter dryers in liquid line between compressor and thermostatic expansion valve for each solenoid valves, and in the suction line at the compressor.

1. Permanent Filter-Driers: Use in low temperature systems, and in systems utilizing hermetic compressors.
2. Replaceable Cartridge Filter-Driers: Use vertically in liquid line adjacent to receivers, and for each solenoid valve.

M. Install receivers sized to accommodate pump-down charge.

N. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

3.6 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping and specialties in accordance with ASHRAE 15 and manufacturers instructions.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connects equipment.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:

1. Shot blast the interior of piping.
2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

R. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

S. Seal penetrations through fire and smoke barriers.

T. Insulate piping.

U. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

V. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

W. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

X. Identify refrigerant piping and valves according to Division 15 Section "Identification for HVAC Piping and Equipment."

3.7 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.8 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports for HVAC Piping and Equipment." Install in accordance with ASTM and M55.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
2. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
3. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
4. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

E. Support multifloor vertical runs with riser clamps, at least at each floor.

F. Install hangers within 12 inches of each horizontal elbow.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.

3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory, no leakage, results are achieved.

3.10 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.11 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 15116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. This section includes water distribution piping and related components inside the building for the domestic water piping system to 5 feet outside the building.

1. Aboveground domestic water pipes, tubes, fittings, and specialties.
2. Dielectric fittings.
3. Flexible connectors.
4. Escutcheons.
5. Sleeves and sleeve seals.
6. Wall penetration systems.

B. Related Section:
1. Division 15 Section 15523 “General Duty Valves for Plumbing Piping.”

1.3 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.
5. Backflow preventers and vacuum breakers.
6. Escutcheons.
7. Sleeves and sleeve seals.
8. Wall penetration systems.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Domestic water piping.
2. HVAC hydronic piping.

3. Electrical conduits.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.5 PROJECT 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 according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Construction Manager's written permission.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:

a. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1) Elkhart Products Corporation; Industrial Division.
2) NIBCO INC.
3) Viega; Plumbing and Heating Systems.

6. Grooved-Joint Copper-Tube Appurtenances:

a. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1) Anvil International.
2) Shurjoint Piping Products.
3) Victaulic Company.

b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Copper Pressure-Seal-Joint Fittings:

a. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1) Elkhart Products Corporation; Industrial Division.
2) NIBCO INC.
3) Viega; Plumbing and Heating Systems.

b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Thickness Class 54, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.

    a. Gaskets: AWWA C111, rubber.

2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.

    a. Gaskets: AWWA C111, rubber.

C. Plain-End, Ductile-Iron Pipe: AWWA C151.

1. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:

    a. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

        1) Anvil International.
        2) Shurjoint Piping Products.
        3) Star Pipe Products.
        4) Victaulic Company.

    b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.

    c. Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 SPECIALTY VALVES

A. Comply with requirements in Division 15 Section 15523 "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. EPCO Sales, Inc.
d. Hart Industries International, Inc.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Description:

a. Pressure Rating: 250 psig at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous.

3. Shall be listed under ASSE Standard No. 1079.

C. Dielectric Flanges:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. EPCO Sales, Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Factory-fabricated, bolted, companion-flange assembly.
b. Pressure Rating: 175 psig minimum.
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 175 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

a. Calpico, Inc.
b. Lochinvar Corporation.

2. Description:

a. Galvanized-steel coupling.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Female threaded.
d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Victaulic Company.

2. Description:

a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

2.7 FLEXIBLE CONNECTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
6. Mason Industries Inc.
7. Mercer Rubber Co.
8. Metraflex, Inc.
9. Proco Products, Inc.
10. Tozen Corporation.
11. Unaflex, Inc.

12. Universal Metal Hose; a Hyspan company

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 250 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

2.8 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

D. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

E. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.9 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.10 SLEEVE SEALS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex, Inc.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

1. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.11 WALL PENETRATION SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. SIGMA.

B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.

1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
3. Housing-to-Sleeve Gasket: NBR.
4. Housing-to-Carrier-Pipe Gasket: AWWA C111, NBR.
5. Pipe Sleeve: AWWA C151, ductile-iron pipe or ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

2.12 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install domestic water piping level without pitch and plumb.

E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. 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.

H. Install piping adjacent to equipment and specialties to allow service and maintenance.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.

H. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.

I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 15 Section 15523 "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at low points in horizontal piping and where required to drain water piping. Drain valves are specified in Division 15 Section 15119 "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 5: Use dielectric flange kits.

3.5 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 15 Section 15529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 5 feet with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 6 feet with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 8 feet with 3/8-inch rod.
4. NPS 2-1/2: 9 feet with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

G. Support of Piping:

1. Provide resilient, spring, and neoprene-supported hangers with mounting that provide a minimum deflection of 7/8 inch for piping not provided with flexible connectors within 50 feet of connected motor-operated equipment.
2. Provide spring elements for pipe hanger mountings with first harmonic natural frequency of no less than 360 cycles per second.
3. Hanger rod isolators shall be equal to Type DNHS-M.I.I.

H. Vertical Pipe Riser Supports:

1. Provide piping connected to motor-operated equipment, within shafts with bearing plates and two layers of 1/4 inch thick ribbed or waffled neoprene pad.
2. Provide isolation pads loaded for maximum 50 psig and separated with steel plate, equal to Type W – M.I.I.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 15 plumbing fixture Sections for connection sizes.
   2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

   1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
   2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
   5. Bare Piping in Equipment Rooms: One piece, cast brass.
   6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

C. Escutcheons for Existing Piping:

   1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
   2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
   3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
   4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
   5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with rough-brass finish.
   6. Bare Piping in Equipment Rooms: Split casting, cast brass.
   7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.9 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint.

G. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using wall penetration systems specified in this Section.

H. Seal space outside of sleeves in concrete slabs and walls with grout.

I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

J. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Stack sleeve fittings.

    a. Extend sleeves 2 inches above finished floor level.
    b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

3. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
4. Sleeves for Piping Passing through Exterior Concrete Walls:

    a. Steel pipe sleeves for pipes smaller than NPS 6.
    b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
    c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
    d. Do not use sleeves when wall penetration systems are used.

5. Sleeves for Piping Passing through Interior Concrete Walls:

    a. Steel pipe sleeves for pipes smaller than NPS 6.
    b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.

K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.10 SLEEVE SEAL INSTALLATION

A. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 WALL PENETRATION SYSTEM INSTALLATION

A. Install wall penetration systems in new, exterior concrete walls.

B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.12 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 15 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate

test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.14 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. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.15 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Clean non-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 procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.16 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
2. Mechanical-joint, ductile-iron pipe; standard- pattern mechanical-joint fittings; and mechanical joints.
3. Push-on-joint, ductile-iron pipe; standard- pattern push-on-joint fittings; and gasketed joints.
4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

F. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.

G. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed joints.

H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed joints.
2. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved joints.
3. On unreduced boosted pressure piping Basement to 1st floor: Cast bronze fittings, standard weight brazing joint or extra heavy threaded.
4. Tempered or tepid water piping shall be the same as for hot water.

I. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed joints.

3.17 VALVE SCHEDULE

A. General:

1. Shutoff: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Drain: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION

SECTION 15119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Hose bibbs.
3. Temperature-actuated water mixing valves.
4. Strainers.
5. Drain valves.
6. Trap-seal primer valves.
7. Trap-seal primer systems.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

C. ASSE Compliance: All products shall be listed under the specific ASSE standard.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

    a. Ames Co.
    b. Cash Acme.
    c. Conbraco Industries, Inc.
    d. FEBCO; SPX Valves & Controls.
    e. Rain Bird Corporation.
    f. Toro Company (The); Irrigation Div.
    g. Watts Industries, Inc.; Water Products Div.
    h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.
7. Equal to Watts No. 288A.

B. Hose-Connection Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

    a. Arrowhead Brass Products, Inc.
    b. Cash Acme.
    c. Conbraco Industries, Inc.
    d. Legend Valve.
    e. MIFAB, Inc.
    f. Prier Products, Inc.
    g. Watts Industries, Inc.; Water Products Div.
    h. Woodford Manufacturing Company.
    i. Zurn Plumbing Products Group; Light Commercial Operation.
    j. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

6. Equal to Watts No. NF8 or No. 8A.

C. Pressure Vacuum Breakers:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Toro Company (The); Irrigation Div.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

2.2 HOSE BIBBS

A. Hose Bibbs HB:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Tee handle.
12. Operation for Service Areas: Tee handle.
13. Operation for Finished Rooms: Tee handle.
14. Include wall flange with each chrome- or nickel-plated hose bibb with supply piping in wall.
15. As manufactured by Watts Drainage Products, Inc. Model No. SC8-6.

2.3 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.

8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
10. Equal to NIBCO Inc. T-585-70-66-HC (threaded); NIBCO Inc. S-585-70-66-HC (solder) non-removable vacuum breaker, equal to Watts No. 8A.

2.4 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

   a. MIFAB, Inc.
   b. PPP Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   e. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves in public toilers and patient handicapped accessible bathrooms with floor drain:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. 2698 or comparable product by one of the following:

   a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.5 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems in mechanical equipment rooms:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

   a. PPP Inc.

2. Standard: ASSE 1044,
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Surface-mounting steel box with stainless-steel cover.

5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Eight.
8. Size Outlets: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

C. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

D. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

E. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 16 Specifications.

C. Connect wiring according to Division 16 Specifications.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Supply-type, trap-seal primer valves.
3. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 15139

WASTEWATER VALVES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of miscellaneous valves and appurtenances not covered under other sections of these specifications.

1.2 SUBMITTALS

Provide specifications, product data and detailed shop drawings in accordance with the requirements of Section 01300, Submittals. Catalog cuts, showing sufficient detail will be acceptable in lieu of detailed drawings for valves smaller than 16 inches in size and for other miscellaneous small items for which detailed drawings are not readily available.

PART 2 - P R O D U C T S

2.1 BASIC REQUIREMENTS

A. All valves and accessories shall conform to the requirements shown and scheduled on the plans and as specified herein.

B. Valve Design.

1. Provide valves designed for repacking or reseating under pressure when fully opened. Perform shell and seat tests and stamp valve to show that tests have been successfully completed.
2. Packing. Use packing suitable for intended service, equipped with gland followers and having pressure and temperature ratings not less than design criteria applicable to components of the system.
3. Seals. For trunnion-mounted valves use resilient seals suitable for the intended service.
4. Provide valves conforming to the following material specifications:

Material	Specifications
Bronze - 150 psi maximum	ASTM B 62
Bronze - 300 psi maximum	ASTM B 61
Cast Iron	ASTM A 126, Class B
Nodular Cast Iron	ASTM A 339, Grade 60-45-10
Carbon Steel, Cast	ASTM A 216, Grade WCB
Carbon Steel, Forged	ASTM A 105, Grade II
Fabricated Steel	ASTM A 7 or better

C. Valve Operators.

1. Unless otherwise shown or specified, each valve must be equipped with a manual operator and shall be provided with a suitable operating wheel.
2. Manual operators on aboveground valves 6 inches and larger shall be geared operators. These geared manual operators shall be fully enclosed and shall be the traveling nut type, rack and pinion type, or worm gear type for valves 20 inches and smaller. The valve shaft shall extend from the valve to the operator and shall be as specified for valve shafts. The space between the operator housing and the valve body shall be

completely enclosed such that no moving parts are exposed to the soil or the elements. Operator housings for valves shall be oil-tight and watertight, shall be specifically designed for buried service, and shall be factory packed and suitably greased. The valve supplier shall install a valve position indicator on each operator housing. Operators 6 feet or less aboveground shall be provided with a handwheel for manual operation.

3. Worm gear operators shall be designed such that a torque in excess of 160 foot-pounds will not have to be applied to operate the valve at the most adverse condition for which valve is designed. Traveling nut operators shall be designed such that a torque in excess of 100 foot-pounds will not have to be applied to operate the valve at the most adverse condition for which the valve is designed. Limit stops shall be installed on the input shaft of all manual operators in the OPEN and CLOSED positions. The vertical axis of the operating nut shall not move as the valve is opened or closed.

4. Any valve which is installed with operator located 6′-1″ or more above the floor and is not required to be equipped with other type of operator shall be provided with suitable chainwheel and operating chain. Each chainwheel-operated valve shall be equipped with chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Operating chains shall be heavily plated with zinc and cadmium and shall be looped to extend to within 4 feet of the floor below the valve.

5. Wrench nuts shall be provided on all buried valves, on all valves which are to be operated through floor boxes, where shown on the plans. All wrench nuts shall comply with Section 20 of AWWA C500. Not less than two operating keys shall be furnished for operation of the wrench nut operated valves, one 6-foot length and one 10-foot length.

6. Unless otherwise shown or specified, plug, ball and butterfly valves 6 inches and less in size shall be lever operated.

7. The direction of rotation of the wheel, wrench nut and lever to open each valve shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word OPEN and an arrow indicating the direction to open.

8. Unless otherwise specified or shown on the plans, all 3-inch or larger buried valves shall have mechanical joint ends or push-on type joint ends. All other 3-inch or larger valves shall have ends conforming to plan drawing and schedule requirements either flanged or grooved-end coupled. Unless otherwise required by the plans, flanges shall conform to ANSI B16.1, Class 125, flat-faced serrated finish to match flanges on piping.

9. Valves 2-1/2 inches or smaller in size may have threaded ends unless otherwise shown on the plans. Screwed end gate valves shall be used in copper tubing.

2.2 GATE VALVES (GTV)

A. Gate Valves, 3 Inches and Larger.

1. Gate valves 3 inches and larger for use in **non-sewage** applications shall conform to AWWA C500, shall be 200 psig SWP, iron body, bronze-mounted, bronze stems, double disc, parallel seat as manufactured by Clow, F-5065 for buried service and F-5070 for above ground service, or approved substitution.

2. Gate valves 3 inches and larger for use in **sewage applications** shall conform to AWWA C500, shall be 125 psig SWP, iron body, bronze-mounted, solid wedge disc as manufactured by American R/D series 100MJ for buried service and series 100 for aboveground service; or Resilient Wedge gate valves conforming to AWWA C509, as manufactured by American R/D series 2055 for buried service and series 2052 for above ground service, sizes 3 inches to 12 inches, or approved substitution. In general, large diameter valve shall not be mounted such that the wedge travels in the horizontal.

2.3 CHECK VALVES (CKV)

A. Swing Check Valves, 3 Inches and Smaller.

1. Horizontal swing, regrinding type, Y-pattern, threaded ends, all bronze construction complying with Federal Specification WW-V51e, Class A, Type IV.
2. Discs shall be either renewable bronze or teflon.
3. Working pressure shall be 125 psi saturated steam, 200 psi non-shock cold water, oil or gas.
4. Valve shall be ITT Grinnell Figure No. 3300 or approved substitution.

B. Swing Check Valves, 4-inch and Larger. Swing check valves 4 inches and larger shall be iron-body, bronze-mounted, full-opening check valves with 125-pound ANSI flanged ends, Mueller No. A-2600-6-01, M&H Style 159, Fabri-Valve 10, Val-Matic Surge-Buster or approved substitution. Valves shall be rated at 175 psig. Valves shall have stainless steel hinge pin keyed to hinge, and adjustable packing glands. Valve shall be equipped with outside lever and weight so constructed and so positioned that it can operate without interference by any piping, supports or equipment.

C. Split Disc Check Valves. Wafer type for mounting between flanges; cast-iron body with bronze-faced plates. Valve openings divided in half using lightweight plates spring locked with stainless steel torsion springs; shaft-mounted internal parts with external shaft seals using NPT socket head pipe plugs. Use resilient seating material suitable for normal pressure and temperature service (20 F to 230°F, typically EDPM), or Viton for high temperature service in applications where temperature may exceed 230°F, bonded in grooved plates. Provide 316 stainless steel body and plate for process air service check valves. Valves shall be as manufactured by Crane Supply (Duo-chek II), Techno Corporation, Henry Pratt Company, or approved substitution. Only for use in process air or potable water service.

D. PVC Ball Check Valves. Ball check valves in PVC piping shall have ASTM D1784, Type I, Grade 1, polyvinyl chloride body with single or dual union socket weld ends, rated 130 psi at 73 F. Valves shall be equipped with EPDM seats and seals. Valves shall be Chemtrol as manufactured by Nibco, Asahi/America, or approved substitution.

2.4 BALL VALVES (BAV)

A. PVC Ball Valves. Thermoplastic ball valves 2 inches and smaller shall be rated 150 psi at 105 degrees F, with ASTM D-1784, Type I, Grade 1, polyvinyl chloride body, ball, and stem. Valves shall be of end entry, true union design. Valves shall have replaceable EPDM seats and O-ring stem seals. Valves shall have handle for manual operation. Valves shall be Chemtrol as manufactured by NIBCO; Asahi/America; or approved substitution.

B. Ball Valve, 2 inches and Smaller. Provide 125-pound cast bronze ball valve, two-piece body, Teflon seats, threaded ends, lever-operated, complying with Federal Spc. WW-V-35b, Type II, Class A, Style 3 (water or air service),

C. Ball Valve, 6 inch through 48-inch. Provide valves in accordance with AWWA C507, latest version. Acceptable manufacturers of rubber seated ball valves include Val-matic, Henry Pratt Company, or approved equal. Acceptable manufacturers of metal seated ball valves include Henry Pratt Company, Dezurik, or approved equal.

2.5 ECCENTRIC PLUG VALVE (PLV)

A. Resilient-seated cast-iron eccentric plug valves, 3 in. through 72 in (round port or "Ballcentric" type). Provide valves in accordance with AWWA C517 (latest version) with flanged, grooved, or mechanical-joint ends. Acceptable manufacturers include DeZurik, Victaulic, Henry Pratt Company, or approved substitution,

B. Resilient-seated cast-iron eccentric plug valves (rectangular port or "cam-centric" type). Provide valves in accordance with AWWA C517 (latest version) with flanged, grooved, or mechanical-joint ends. Acceptable manufacturers include DeZurik, Val-matic (cam-centric), or approved substitution. Rectangular port area of valve shall be not less than 80 percent of full pipe size.

C. Valves shall be cast iron (ASTM A 126, Class B) with resilient-faced plugs. Valve seat shall have a welded-in overlay of not less than 90 percent nickel on all surfaces contacting the plug face. The stem bearing and bottom bearing shall be of Type 316 stainless steel. Valves shall be designed for 150 psig working pressure. Valves shall open counterclockwise.

D. The plug shall be coated with a resilient material which is oil and grease resistant, such as neoprene or Buna-N. Valves shall be adjustable and repackable without removal of valve bonnet while valve is in service. Valves 3 inches and larger shall be furnished with 125-pound ANSI flanged ends or, if Victaulic joints are used, with grooved ends.

E. Unless otherwise shown on the drawings, valves 6 inches and smaller shall be lever operated and valves 8 inches and larger shall be provided with enclosed worm gear handwheel operators. Equip buried plug valves with valve box and operating nut extensions.

2.6 BUTTERFLY VALVES (BFV) – WATER SERVICE

Valves and operators shall conform to latest addition of AWWA Standard for Rubber-seated Butterfly Valves, AWWA C504, except as modified or supplemented herein. All manually operated valves for open-close service 20 inches in size and smaller shall be Class 150 B. Provide valves with cast iron body, cast iron or bronze disc, and a stainless-steel type 304 shaft. All portions of the shaft bearings shall be stainless steel, bronze, nylon, fiberglass and/or Teflon in accordance with AWWA C504.

A. Seats shall be of one-piece construction, simultaneously molded and bonded into a recessed cavity in the valve body. Seats may not be located on the disc or be retained by segments and/or screws. For wafer style valves, the seat shall cover the entire inner surface of the valve body and extend over the outside surface of the valve body to form a flange gasket.

B. Provide locking lever operators on all valves through 6 inches. Use standard enclosed weatherproof gear operators on all valves larger than 6 inches. Operator mounting arrangements and handwheel positions shall be easily accessible or as shown on the plans. Provide all valves with a valve disc position indicator mounted on the end of the valve shaft.

2.7 BUTTERFLY VALVES (BFV) – AIR SERVICE

A. Valve shall be wafer (or lug wafer) design for installation between ANSI B16.1 125-pound flanged ends. All valves shall be capable of bi-directional, bubble tight service to the rated pressure. Provide valves with cast iron body, cast iron or bronze disc, and a stainless-steel type 416 shaft.

B. For plant air service, provide valves with resilient seats capable of withstanding temperatures reaching 230°F (minimum) such as EPDM or Viton. Seats shall be located in the valve body and be field replaceable.

C. Shaft seal shall be V-type and shall be suitable for pressure or vacuum service.

2.8 KNIFE GATE VALVES (KGV)

A. Water Service

1. Provide valves with full round port opening and metal seat of 304 stainless steel for particular valve service as recommended by manufacturer. All flanges to be drilled and tapped in accordance with ANSI

Class 125/150 standard. Valves 24 inches in size and smaller shall have pressure rating of 150 CWP; valves greater than 24 inches shall have pressure rating of 125 CWP.

2. All wetted parts of knife gate valves, including gate, seat rings and metal seat, through the body and in the chest shall be of Type 304 stainless steel. The stem shall also be stainless steel and shall have double pitch threads. Valves shall have an adjustable packing gland.

3. Valves shall be installed so that liquid pressure from the service will push the gate on the seat when closed. Mark all valves and identify seating side of valve.

4. Hydrostatically test the body of the valve at 1.5 times the working pressure.

5. Knife gate valves through 8 inches in size shall have handwheel operators; valves 10 inches and larger shall have enclosed bevel gear with handwheel operators, floor stands, gate position indicator, extension and fittings as required.

6. Provide lug body style, bonnetless knife gate valves. Valves as manufactured by Fabri-Valve (37R), DeZurik (Series L) or approved substitution.

B. Air Service

1. Square diaphragm control valve with central or falling flow axis with range of 0 – 100%, gas tight at closed position. For control service, supply as a unit with electrical multi-turn actuator for sensitive control of air supply. Valve is to have low pressure drop.

2. For manual trim operation, supply with manual actuator, gear reducer, and position indicator.

3. Provide wafer body style, Vacomass control valve as manufactured by BinderGroup or approved substitution.

2.9 TELESCOPING VALVES (TLV)

A. Tubes shall be manufactured from seamless or welded stainless steel tube. Connecting bails and hardware shall be 304 stainless steel. Minimum wall thickness for tube shall be 1/8 inch. Tube will be of sufficient length to provide adjustment between the elevations as shown on the plans.

B. A seal flange and retainer plate made of type 304 stainless steel and two (2) Buna-N slip seal gaskets shall be provided by the valve manufacturer. The slip seal gasket ID shall be 1/8" smaller than slip tube OD. The seal flange and retainer plate shall be 1/4" thick and slip seal gaskets 1/4" thick each. Slip seal gaskets shall be "dovetailed" in order to facilitate easy replacement in the field without disassembly of valve. The gaskets shall be sandwiched in between the seal flange and the retainer plate, which are to be bolted to the riser pipe flange. The gaskets, sealing flange and retainer plate are to be supplied with standard class 125# drilling pattern to match the riser pipe flange. Riser pipe shall be provided by Contractor.

C. Slip tube shall be fitted with 12-inch diameter 304 stainless steel funnel. Bail shall attach to funnel.

D. Stems shall be manufactured from solid Type 304 stainless steel rod and shall have Acme type threads for adjusting the tube height. The stem shall be fastened to the tube bail by welding or threaded stainless steel hardware. Provide bails of adequate profile to minimize debris collection and to facilitate cleaning.

E. Valves shall be rising stem with electric motor actuators. Actuators shall be mounted to a pedestal or offset pedestal as required. Pedestal shall be of cast 316 stainless steel or cast ductile iron epoxy coated. Fabricated pedestals are not acceptable. The threaded stainless-steel operating stem shall be used to connect the operating mechanism to the valve tube lifting bail. The threaded segment shall engage the operating nut in the electric motor

actuator. Operators shall be supplied with clear plastic stem covers, vented cover cap and Mylar position indication tape. Electric motor actuators shall have a 6-inch manual handwheel and be suitable for 480V, 3 phase power.

F. Stem guides where required shall be of cast 316 stainless steel or cast ductile iron epoxy coated with bronze bushings. Stem guides shall be adjustable in two directions to assist in proper stem installation and alignment. Wall brackets for offset pedestals shall be of cast 316 stainless steel or cast ductile iron epoxy coated.

2.10 MUD VALVES

Valves shall be flanged end, cast iron body with bronze seats. Provide 304 stainless steel non-rising stem with bronze stem nut. All assembly and mounting bolts to be 316 stainless steel. Valve will be operated with a handwheel lift. Provide stem guides and wall brackets to make a complete and operable unit as required by valve manufacturer.

2.11 MISCELLANEOUS VALVES

A. Flap Valves. Flap valves shall be installed where shown on the drawings. Valves shall have iron body bronze seats and disc rings; hinge pins shall be bronze or Type 316 stainless steel.

B. Globe Valves (GLV).

1. Globe valves shall be used where indicated on the drawings or specified. In general, unless otherwise shown or noted, all valves 1/2 inch and smaller on water or air lines shall be globe valves. Angle valves may be used in place of globe valves where convenient.
2. Globe valves 3 inches in size and smaller for ordinary service shall be 125 psig SWP, bronze rising stem, bronze disc globe valves with screwed ends, Crane Nos. 1 and 2, Kennedy Figures 150 and 151, or approved substitution.

C. Hose Bibbs (HB). Hose bibbs shall be bronze, angle pattern globe-type valves with renewable composition disc and American Standard hose coupling threads on outlet. Hose valves shall be Nibco KT-67-UL for 1-inch bibb and Nibco T-301-W for 1-1/2-inch bibb, or approved substitution.

D. Globe Needle Valve, 1/8 inch to 3/4-inch Size. Screwed bonnet, rising stem, threaded ends, brass stem and integral seat. Provide ITT Grinnell Figure No. 1066 or approved substitution.

E. Relief Valves. Furnish spring-loaded relief valves with a steel bonnet and 316 stainless steel trim with enclosed spring similar to Crosby Series 900. Valve to be compatible with service. For compressed air service use seats specially ground for air service and provide a lifting lever.

F. Sewage Combination Air/Vacuum Valve (Force Main High Points, Pump Station Discharge).

1. Operation. Allow for unrestricted venting or re-entry of air through valve during filling or draining of the pipe. Valve design is to prevent water column separation or pipeline collapse due to vacuum. Combination valve does not spill or spurt sewage even at low pressures.
2. Materials. Valve Body - Non-corrosive composite materials. Operating parts – corrosion resistant polymers. Float rod and spring – Stainless Steel
3. Appurtenances. All internals shall be removable through the top cover. Provide blow-off valves, quick disconnect couplings, minimum 6 feet of hose and flanged gate valve.
4. Valves shall be ARI D-025, or approved substitution.

G. Tank Pressure Relief Valves.

1. Wall Type Relief Valve. Valves shall have a removable strainer retained in the valve. Pressure Relief Valves without strainers or with strainers in the Wall Pipe are not acceptable. Wall Pipe shall have

bolt holes tapped for studs, to allow for flush mounting of the valve to the tank wall. Flange on both Wall Pipe and Wall Valve shall comply with ANSI Class 125 for outside diameter, bolt circle and number of bolts. Flange thickness for 4" valves shall be a minimum of 7/16"; 6" valves shall be a minimum of 1/2". Hinge pin connecting the body and lid shall be made of stainless steel. Hinge pins of bronze are not acceptable. The wall type pressure relief valve shall be a Trumbull 1367-1560 (4-inch) or 1367-1564 (6-inch), or approved substitution.

2. Floor Type Relief Valve. Valves shall have an integrally cast collar. The lid shall have locking lugs to prevent separation from the valve body. Floor type valves shall have a removable strainer. The length of floor type valves shall be extended with the use of C900 PVC Pipe, having the same OD as ductile iron pipe. The C900 Pipe shall be securely retained by a "Reiber Style, Angled Gasket" inside the casting. O-Rings are not acceptable for retaining C900 PVC Pipe. The floor type pressure relief valve shall be a Trumbull 1367-1540 (4-inch) or 1367-1544 (6-inch). or approved substitution.

3. Tank Pressure Relief Valves shall be installed as shown on the drawings to prevent sub-grade concrete tanks from becoming buoyant and floating from hydrostatic pressure, or to prevent damage to the tank side walls. A pocket of clean crushed stone approximately 3/4" to 2" in diameter should be placed at the external port of the Wall Pipe or Floor Valve unless otherwise shown on the drawings. The cover shall open when the external pressure exceeds internal pressure by approximately 5" of head, so that pressure will be equalized on the inside and outside of the tank. All valves shall be cast stainless steel, type 316.

4. Seals. Seals on both body and lid shall be Neoprene, 40 durometer and be field-replaceable. The surfaces on the body and lid where the seals are installed must be machined to insure an overall flush and parallel seating surface. Seals shall be the QuadroSeal "wrap-around" design that surrounds body and lid on four sides to prevent separation. In addition, seals shall be bonded to body and lid with an adhesive sealant. Designs which rely solely on adhesive are not acceptable. The seals shall be secured to the valve body and lid at their outer perimeters to assure adequate sealing contact. Designs that retain the seal to the lid by means of a screw in the center of the lid are not acceptable. Tank Pressure Relief Valves shall be QuadroSeal as provided by Trumbull Industries, or approved substitution.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of miscellaneous valves shall be as recommended by manufacturer. Valves shall be positioned as shown on drawings.

B. Prior to installing valves, remove foreign matter from within the valves. Inspect the valves in open and closed position to verify that all parts are in satisfactory working condition. Geared valves shall be inspected to see that the gears are properly lubricated.

C. Each valve which is installed in direct contact with earth backfill shall be provided with a valve box of such type and design that surface loads, impact and shock will not be transmitted through the box to the valve.

D. Install valves and valve boxes at locations indicated on drawings or as alternatively located by Owner's Inspector. Valves and valve boxes shall be set plumb.

E. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade.

F. Locate valves away from roads or streets, if applicable.

G. After being placed in proper position, earth shall be filled in around each valve box and thoroughly tamped for a distance on each side of the box of 4 feet at the top of the pipe and 2 feet measured at the top of the trench.

H. Place a concrete thrust block opposite pipe connections and set against the vertical face of the trench to prevent the valve from blowing off the line. If character of the soil is such that the valve cannot be securely wedged in this manner, provide bridle rods and rod collars of not less than 3/4-inch stock coated in acid-resistant paint.

I. Extension stems for buried valves shall extend to within 6 inches of the surface of the ground. Each extension stem shall be connected to the valve operator with a suitable universal joint type coupling. All connections shall be pinned. Each extension stem shall be provided with spacers which will center the stem in a valve box having an inside diameter of 5-1/2 inches and shall be equipped with a standard AWWA wrench nut as described in Section 20 of AWWA C500.

3.2 PAINTING

A. Unfinished interior surfaces of all valves shall be painted or coated for wastewater service in conformity with the standard practice of the manufacturer. All unfinished exterior surfaces of the valves, operators and accessories which are not exposed in manholes, buried or submerged shall be thoroughly cleaned and prime coated with primer compatible with the proposed coating system. Finish coats of paint will be applied after installation of the valves.

B. All exterior surfaces of valves which are exposed in manholes, buried or submerged, and their extension stems and accessories shall be thoroughly cleaned and coated.

C. All polished or machined surfaces of each valve shall be coated with rust-preventative compound, Dearborn Chemical "No-Ox-Id 2W," Houghton "Rust Veto 344," or Rust-Oleum "R-9."

END OF SECTION

SECTION 15316

STORM DRAINAGE, SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

1.3 This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

B. Related Sections include the following:

1. Division 22 Section 15529 “Hangers and Supports for Plumbing, Piping and Equipment.”

1.4 DEFINITIONS

1.5 Retain abbreviations that remain after this Section has been edited.

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. LLDPE: Linear, low-density polyethylene plastic.

C. NBR: Acrylonitrile-butadiene rubber.

1.6 PERFORMANCE REQUIREMENTS

1.7 Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Storm Drainage Piping: 40 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.8 SUBMITTALS

1.9 Retain first paragraph below if required.

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

C. Field quality-control inspection and test reports.

1.10 QUALITY ASSURANCE

1.11 Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products.

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Basis-of-Design Product: Subject to compliance with requirements, provide manufacturer's name, product name or designation, or comparable product.

2.3 PIPING MATERIALS

2.4 See "Writing Guide" Article in the Evaluations for a discussion of this Section's organization and the most efficient way to edit this Section.

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.5 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

2.6 Pipe, fittings, and couplings in first two paragraphs below are available in NPS 1-1/2 to NPS 15 (DN 40 to DN 375).

A. For above ground sanitary and vent piping .

B. Pipe and Fittings: ASTM A 888.

C. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Basis-of-Design Product: Subject to compliance with requirements, provide manufacturer's name, product name or designation, or comparable product by one of the following:

1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.

2. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

a. Basis-of-Design Product: Subject to compliance with requirements, provide manufacturer's name; product name or designation or comparable product by one of the following:

1) MG Piping Products Co.

D. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Basis-of-Design Product: Subject to compliance with requirements, provide manufacturer's name; product name or designation or comparable product by one of the following:

a. ANACO.

2.7 STEEL PIPE AND FITTINGS

2.8 Pipe in paragraph below is available in NPS 1/8 to NPS 26 (DN 6 to DN 650).

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Grooved-Joint Systems:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
a. Anvil International.
b. Victaulic Company.
c. Ward Manufacturing, Inc.
2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.9 EXECUTION

PART 3 - PIPING APPLICATIONS

3.1 Select piping applications from this Article. Coordinate with materials specified in Part 2. Revise to suit Project.

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

C. Aboveground soil and waste piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

D. Aboveground vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

E. Aboveground, vent piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

3.2 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 15 Section "Common Work Results for Plumbing."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Common Work Results for Plumbing."

D. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Install storm, soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Sanitary Drainage Piping: 2 percent downward in direction of flow, NPS 2 and smaller at 1/4 inch per foot minimum, 1 percent downward in direction of flow, NPS 3 and larger at 1/8 inch per foot minimum.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

J. Hubless piping shall be installed in a rigid, linear, and plumb system without any deflection at the joints either horizontally or vertically. The system shall be supported and secured to the building structure to prevent movement induced by a ten-foot head of water and its associated thrust forces.

1. When horizontal hubless CI piping is suspended in excess of 18 inch by means of non-rigid hangers, provide sway bracing to prevent horizontal movement.
2. For all horizontal hubless CI piping 5-inch and larger, provide sway bracing to prevent horizontal movement at every branch opening and change of direction by securing to building structure, or provide pipe clamps and rodding across coupling.

3.3 JOINT CONSTRUCTION

3.4 Basic piping joint construction requirements are specified in Division 15 Section "Common Work Results for Plumbing."

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

E. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.5 VALVE INSTALLATION

3.6 Retain this Article if valves are required.

A. General valve installation requirements are specified in Division 15 Section 15519 "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 and smaller.
2. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install non-slam swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.7 HANGER AND SUPPORT INSTALLATION

3.8 Pipe hangers and supports are specified in Division 15 Section 15529 "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section 15529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

3.9 CONNECTIONS

3.10 Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

D. Sanitary drains to terminate 5 ft. outside building, connection to street sewers by civil engineer.

3.11 FIELD QUALITY CONTROL

3.12 Portions of testing and inspection requirements in this Article are taken from model plumbing codes. Edit if requirements vary.

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.13 CLEANING

3.14 Clean interior of piping. Remove dirt and debris as work progresses.

A. Protect 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.

END OF SECTION

SECTION 15319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Through-penetration firestop assemblies.
   4. Miscellaneous sanitary drainage piping specialties.
   5. Flashing materials.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

   1. Wiring Diagrams: Power, signal, and control wiring.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Josam Company; Blucher-Josam Div.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot or hubless, cast-iron soil pipe T-branch or as required to match connected piping.
5. Closure: Countersunk or raised-head, plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.
    f. Kusel Equipment Co.

g. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Cast bronze cleanouts. Full size up to four inch, and at least half size for larger pipes, but with four inch minimum.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast bronze.
6. Clamping Device: Not required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium or Heavy Duty as applicable.
13. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.
19. Integral flashing flange and clamping ring in floors with built up membrane. Four inch wide flange in floors with liquid membrane. Four inch wide flange at required depth in floors with elastomeric membrane.
20. Where cleanouts are provided for piping buried in or under floor or in inaccessible hung ceilings, extend piping and terminate with the following type deckplates, except as noted:

    a. Equal to Smith No. 4890, Zurn ZANB-1456-1C, MIFAB C1230-1.
    b. Heavy duty type with secured top in wheeled traffic areas, equal to Smith No. 4108, Zurn ZN1400-HD-1C, MIFAB C1100-XR, and to Smith No. 4228, Zurn ZB 1400-HD-1C, MIFAB C1100-XR (cast iron top). Fill adjustment space with hot mastic.
    c. In elastomeric type floors, equal to Smith No. DX-4890, Zurn ZANB-1456-DX-1L, MIFAB C1230-1.
    d. In membrane waterproofed floors, bronze taper thread CO plug and an adjustable cast extension neck, equal to MIFAB C1100-R, Smith 4128, Zurn Z-1449-BP and ZANB-1456-1C.
21. Bronze top cleanouts in machinery and storage rooms. Satin finish nickel bronze top cleanouts elsewhere. Provide two spanner wrenches of each size used.
22. Cleanouts for piping buried in or under floor, extend piping and terminate with flush cast bronze plugs, equal to MIFAB C1230, Smith No. 4283 or 4288 or Zurn Z1449.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, nickel-bronze, stainless-steel wall-installation frame and cover, equal to Smith No. 4532 or Zurn Z1446.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains Except as Noted:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Dimensions of Top or Strainer: 6 inches.
16. Funnel: Not required.
17. Inlet Fitting: Not required.
18. Trap Material: Cast iron.
19. Trap Pattern: Deep-seal P-trap.
20. Trap Features: Trap-seal primer valve drain connection.

B. General:

1. In accordance with ANSI A112.21.1 and where required for the following construction types. For built up membrane, provide a flashing clamp. For liquid membrane, provide a four inch wide flange. For elastomeric type floor, provide a four inch wide top flange at required height. Provide strainers with a nickel bronze finish except as noted.
2. Provide a coated cast iron body, except as noted, with integral double drainage flange and weep holes, inside caulked outlet or hub outlet for compression gasket connection, or hubless outlet except as noted.

3. Type FD '1', General: An adjustable extension neck and 6-inch diameter cast strainer, flashing clamp for membrane, equal to MIFAB 1100C, Smith No. 2010-A or Zurn ZN-415-6B.
4. Type FD '1', Showers: five-inch diameter strainers for 2-inch outlet size.
5. Type FD '2', In machinery rooms and unfinished areas, adjustable cast iron extension neck and maximum diameter bottom bar strainer on short legs, equal to MIFAB F1320C, Smith No. 2320 or Zurn Z520 for 3-inch outlet and MIFAB 1340, Smith 2340 for 4 inch and 6-inch outlet modified without top grate.
6. Type FD '3', Same as FD '1' with recessed grating.
7. Floor drains shall be provided with trap primer connection.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 10 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings For FD '1' and FD '2':

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and

galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.
3.

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

L. Install traps on plumbing specialty drain outlets.

M. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 15400

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 WORK IN THIS SECTION

A. Work in this Section includes the providing of labor, materials, equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdiction for the following:

1. Plumbing fixtures and trim, faucets, other fittings and related components.

1.3 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Laminar-flow faucet-spout outlets.
3. Flushometers.
4. Toilet seats.
5. Protective shielding guards.
6. Fixture supports.
7. Water closets and accessories.
8. Lavatories and accessories.

B. Related Sections include the following:

1. Division 15 Section 15119 "Domestic Water Piping Specialties" for floor drains and specialty fixtures not included in this Section.

1.4 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.5 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities; A117.1, “Specifications for making buildings and facilities accessible to and usable by physically handicapped people”.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
1. Vitreous-China Fixtures: ASME A112.19.2M.
2. Water-Closet, Flush Valve, Trim: ASME A112.19.5.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Brass Waste Fittings: ASME A112.18.2.
5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Floor Drains: ASME A112.6.3.
2. Grab Bars: ASTM F 446.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.7 WARRANTY

Warranty Period for Commercial Applications: Three years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

A. Wall outlet vitreous china flushometer type with elongated rim bowls, top inlet, cast iron floor flange, impregnated felt gasket, brass holding bolts, washers, nuts and china caps or flat bolt covers.

1. See schedule on drawings for model number.

B. Water Closet Flushometer

1. Quiet flushing, non-hold-open diaphragm type with vacuum breaker, metal handle, 1 inch capped quiet stop and 1.28 or 1.1 gallon flush for top spud water saver type closets.

C. Seats

1. White heavy solid plastic elongated type seats with integral molded brass or stainless steel check hinges, equal to Olsonite No. 10CC open front.

D. Supports:

1. Provide J.R. Smith Fig. 440 Series fixture support for single fixture and Fig. 240 Series for back to back support.

2.2 SINKS

A. Provide with galvanized bonderized steel wall flanges on sides as required, stainless steel protective caps on exposed curbs, and three-inch chrome plated brass drain cast integral.

1. See schedule on drawings for model number.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
4. Lag fixture carrier base plates or feet to slab with lead expansion shields and insert bolts in all bolt holes.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 15 Section "General-Duty Valves for Plumbing Piping."

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install toilet seats on water closets.

N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

Q. Install traps on fixture outlets.

R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 15 Section "Common Work Results for Plumbing."

S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 16 Specifications.

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 15517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
3. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
4. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 8 and Larger: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 8 and Larger: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 8 and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 8 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

SECTION 15518

ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with rough-brass finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with rough-brass finish.

2. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.
f. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 15523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Steel ball valves.
3. Bronze gate valves.
4. Iron gate valves.

B. Related Sections:

1. Division 15 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. PTFE: Polytetrafluoroethylene plastic.

F. OS&Y: Outside screw and yoke.

G. RS: Rising stem.

H. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

C. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

D. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

H. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.

a. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Nib-seal handle extension or comparable product by one of the following:

1) Conbraco Industries, Inc.; Appollo Div.

I. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves, ASME B16.5 for steel valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T-560-BR-R-20 or a comparable product by one of the following:

a. Conbraco Industries, Inc.; Apollo Div.
b. Jamesbury, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 6400 psig.
c. Body Design: One piece with separate packnut and adjustable stem packing.

d. Body Material: Bronze ASTM B 584 Alloy C844.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-595-Y or T-595-Y or a comparable product by one of the following:

a. Conbraco Industries, Inc.; Apollo Div.
b. Jamesbury, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Three piece with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
e. Body Material: Bronze ASTM B 584 Alloy C844.
f. Ends: Threaded or Solder.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

C. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-595-Y-66 or T-595-Y-66 or a comparable product by one of the following:

a. Conbraco Industries, Inc.; Apollo Div.
b. Jamesbury, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Three piece with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
e. Body Material: Bronze ASTM B 584 Alloy C844.
f. Ends: Threaded or Solder.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 STEEL BALL VALVES

A. Class 15, Full-Port Steel Ball Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-515-CS-F-66-FS or a comparable product by one of the following:

a. Conbraco Industries, Inc.; Apollo Div.
b. Jamesbury, Inc.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 285 psig.
c. Body Design: Split body.
d. Body Material: Carbon steel ASTM A 216, type WCB.
e. Ends: Flanged.
f. Seats: PTFE or TFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

2.4 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-113 or T-113 or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Powell Valves.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or Solder.
e. Stem: Copper-silicon bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

B. Class 125, RS Bronze Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-111 or T-111 or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Powell Valves.

2. Description:

   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded or solder.
   e. Stem: Copper-silicon bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron.

C. Class 150, NRS Bronze Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-136 or T-136 or a comparable product by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Powell Valves.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 300 psig.
   c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
   d. Ends: Threaded or solder.
   e. Stem: Copper-silicon bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron.

D. Class 150, RS Bronze Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-134 or T-134 or a comparable product by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Powell Valves.

2. Description:

   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 300 psig.
   c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
   d. Ends: Threaded or solder.
   e. Stem: Copper-silicon bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron.

E. Class 200, RS Bronze Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-154 or T-154 or a comparable product by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Powell Valves.

2. Description:

   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 400 psig.
   c. Body Material: ASTM B 61, bronze with integral seat and union-ring bonnet.
   d. Ends: Threaded or solder.
   e. Stem: Copper-silicon bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron.

2.5 IRON GATE VALVES

A. Class 125, NRS, Cast-Iron Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-619 or a comparable product by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Powell Valves.

2. Description:

   a. Standard: MSS SP-70, Type I.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Disc: Solid wedge.
   g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Cast-Iron Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-617-O or a comparable product by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Powell Valves.

2. Description:

   a. Standard: MSS SP-70, Type I.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.

d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

C. Class 150, NRS, Ductile-Iron Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-639-31 or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Powell Valves.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 285 psig.
c. Body Material: ASTM A 395, ductile iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

D. Class 150, OS&Y, Ductile-Iron Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-637-31 or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Powell Valves.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 285 psig.
c. Body Material: ASTM A 395, ductile iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball, gate and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Gate valves.
2. Throttling Service: Globe valves.
3. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
    c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
3. Bronze Lift Check Valves: Class 125, nonmetallic TFE disc.
4. Bronze Swing Check Valves: Class 150, nonmetallic TFE disc.
5. Bronze Gate Valves: Class 150, RS.
6. Bronze Globe Valves: Class 150, nonmetallicdisc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel Ball Valves: Class 150, full-port.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and weight.
5. Iron Gate Valves: Class 125, OS&Y.
6. Iron Globe Valves: Class 125.

3.6 SHUT-OFF VALVES

A. On stainless steel piping, provide type 316 stainless steel rising stem gate type with threaded ends, 200 psig wwp, equal to Powell No. 1832. For tubing, provide with stainless steel adapters.

END OF SECTION

SECTION 15529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Pipe stands.
6. Pipe positioning systems.
7. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Powder-actuated fastener systems.
3. Pipe positioning systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Anvil International.
3. Bergen-Power Pipe Supports.

4. B-Line Systems, Inc.; a division of Cooper Industries.
5. Carpenter & Paterson, Inc.
6. Empire Industries, Inc.
7. ERICO/Michigan Hanger Co.
8. Globe Pipe Hanger Products, Inc.
9. Grinnell Corp.
10. GS Metals Corp.
11. National Pipe Hanger Corporation.
12. PHD Manufacturing, Inc.
13. PHS Industries, Inc.
14. Piping Technology & Products, Inc.
15. PSI Corp.
16. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2. Expansion Anchors:

a. Smooth wall, non-self-drilling internal plug expansion type anchors constructed of AISC 12L14 steel and zinc plated in accordance with Fed. Spec. QQ-A-325 type 1, Class 3.
b. Do not exceed 1/4 of average values for a specific anchor size using 2000 PSIG concrete only, for maximum working loads.
c. Locate spacing and install anchors in accordance with the manufacturer's recommendations.
d. Expansion anchors shall be U.L. listed and equal to Hilti HDI.

2.6 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers:

a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Portable Pipe Hangers.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturers:

a. Portable Pipe Hangers.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Manufacturers:

1. C & S Mfg. Corp.
2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. 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 120 to 450 deg F pipes, NPS 4 to NPS 16, 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 24, 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 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-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.
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 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 2 rods if longitudinal movement caused by expansion and contraction might occur.

G. 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 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. 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.

a. Inserts shall be steel, slotted type and factory-painted.

1) Single rod shall be equal to Anvil International Fig. 281.
2) Multi-rod shall be equal to Carpenter Patterson Series with end caps and closure strips.
3) Clip form nails flush with inserts.
4) Maximum loading including pipe, contents and covering shall not exceed 75% of rated insert capability.

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.
16. Supports from Steel Decks:

a. Pipes:

1) Maximum Size: 8 inch diameter.
2) Hanger Spacing: Maximum 12 ft centers.

b. Support piping from steel deck with metal deck ceiling bolt, equal to Carpenter and Patterson Figure 143.

J. 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.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 15 Section 15400 "Plumbing Fixtures" for plumbing fixtures.

H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal 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.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

O. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

P. Suspended Horizontal Piping:

1. Support piping independently from structure using heavy iron-hinged type hangers, equal to Anvil International Clevis No. 260.
2. Provide electroplated solid-band hangers equal to Auto-Grip, for 2-inch and smaller pipe.
3. Provide trapeze hangers of angles, angles bolted back-to-back, or channels to parallel lines of piping.
4. Provide wall brackets for wall-supported piping, and furnish pipe saddles for floor-mounted piping.
5. Provide supports with copper lining for uninsulated copper piping.
6. Suspend piping from inserts, using beam clamps with retaining clamp or locknut, steel fish plates, cantilever brackets or other accepted means. Beam clamps shall be equal to Anvil International Figures 61, 87, 131, or 225.
7. Suspend piping by rods with double nuts.
8. Provide additional steel framing as required and accepted where overhead construction does not permit fastening hanger rods in required locations.
9. Support branch fixture water piping in chases with copper-plated metal brackets, secured to studs, equal to Holdrite Nos. 102-18, 107-18, 102-26, or 101-26.

3.3 EQUIPMENT SUPPORTS

A. Mount on or support from accepted foundations and supports, all noted equipment and related piping.

B. Ensure that lateral motion under equipment at start-up, shut-down or when unbalanced is no more than a maximum of 1/4 inch.

C. Provide corrosion resistant mounting systems. Provide hot dip galvanized metal parts of mountings (except springs and hardware). Provide cadmium-plated and neoprene-coated springs and cadmium-plated nuts and bolts.

D. Correct noise and vibration problems due to faulty equipment or poor workmanship, as directed, without additional charge to Owner.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

C. Dip in epoxy primer, uncoated hangers, supports, rods, and inserts.

D. Epoxy primer shall be Sherwin Williams MIL-P53022B, or approved equal.

END OF SECTION

SECTION 15553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Requirements for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

1. Factory fabricated, snap-on type pipe markers every 10 feet indicating system and direction of flow. The pipe markers shall be the weather-proof plastic type and shall not be used where surface temperature exceeds 180 deg F.
2. The pipe markers shall be equal to Seton Name Plate Corporation “Setmark”, with the following types:

    a. Smaller than 6 inch: Setmark SNA, completely encircling pipe.
    b. 6 inch and larger: Setmark STR, stainless steel spring fasteners.
    c. Adhesive type markers will not be permitted.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.
4. Mark piping every 10 feet indicating system and direction of flow. Clearly stencil letters and flow arrows with flat black paint, using block letters on a white background. Sizes of stencil are as follows:

Outside Diameter of Pipe Covering	Size of Stencil
3/4 inch – 1-1/4 inch	1/2 inch
1/2 inch – 2 inch	3/4 inch
2-1/2 inch – 6 inch	1-1/4 inch

5. Indicate system and direction of flow on piping, using above table, but stenciling will be done by Painting Contractor. Supervise stenciling to assure that it is readable from the floor.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: 2 inch square Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.
3. Equal to Seton Name Plate Corp.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Mount charts on walnut grained wood plaque with clear plastic laminations covering diagrams and/or lists.

2. Mount charts, diagrams, and/or lists, in aluminum frame and glass.

3. Letter and number equipment, valves and controls to correspond with designations on metal tags and/or nameplates.

4. Fasten permanently in locations, as directed, with four brass screws.
5. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment, and for gauges, meters, valve boxes, instruments, control devices, pilot lamps, transmitters, motor controllers, and panel-mounted equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels , complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 10 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Where removable ceiling tiles are provided, install buttons, tabs, or markers to identify location of concealed work and/or valves. Submit for review.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:

   a. Background Color: White.
   b. Letter Color: Blue.

2. Sanitary Waste Piping:

   a. Background Color: White.
   b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 2 inches, round.
   b. Hot Water: 2 inches, round.

2. Valve-Tag Color:

   a. Cold Water: Green.
   b. Hot Water: Green.

3. Letter Color:

   a. Cold Water: Black.
   b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 15719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Results for Plumbing apply to the work specified in this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

D. Qualification Data: For qualified Installer.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg FMaterials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Ramco Insulation, Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Johns Manville; Zeston.
   b. P.I.C. Plastics, Inc.; FG Series.
   c. Proto Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper2.5-mil-.
   e. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

   a. Sheet and roll stock ready for shop or field sizing.
   b. Material, finish, and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
   e. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 1/2 inchor .
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inchnickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 milsthick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

D. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot Water:

1. 1-1/4" and Smaller: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. 1-1/2" and Larger: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inchthick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
1. PVC30 mils thick.
2. Aluminum, Corrugated 0.020 inch thick.

D. Piping, Exposed:
1. Stainless Steel, Type 304 Corrugated: 0.020 inch, 0.024 inch thick.

END OF SECTION

SECTION 15740

SPLIT-SYSTEM AIR-COOLED AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed mounting.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, dimensions, connections for piping and electric, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance: Applicable requirements in the latest edition of ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1 Latest Edition Compliance: Applicable requirements in the latest edition of ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.5 COORDINATION

A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases.

B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations.

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: Five years from date of Substantial Completion.

1.7 DELIVERY AND STORAGE

A. Deliver products to site and store and protect products until installation.

B. Protest finished cabinets from physical damage by leaving factory packing cases in place before installation and by providing temporary covers after installation.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of filters for each unit.
2. Fan Belts: One set of belts for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. LG.
2. Daikin.

3. Mitsubishi.

2.2 CEILING-MOUNTING, EVAPORATOR-FAN COMPONENTS

A. Cabinet: Enameled steel with removable front panel.

1. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest edition of ASHRAE 62.1.
2. Drain Pan and Drain Connection: Comply with the latest edition of ASHRAE 62.1.

B. Refrigerant Coil: Staggered copper tubing, with corrosion inhibiting mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

D. Fan: Direct drive, centrifugal fan and integral condensate pump.

E. Fan Motors: Comply with requirements in Division 15 Section "Common Motor Requirements for HVAC Equipment."

1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

F. Filters: Cleanable, with ASHRAE 52.2 MERV rating of 6 or higher.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Galvanized steel, finished with corrosion inhibiting baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1. Compressor Type: Reciprocating or Scroll.
2. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
3. Refrigerant: R-407C or R-410A.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.

E. Fan: Aluminum-propeller type, directly connected to motor.

F. Motor: Permanently lubricated, with integral thermal-overload protection. Provided with heavy gauge wire fan guards.

G. Low Ambient Kit: Permits operation down to 45 deg F.

H. Minimum Energy Efficiency: Comply with the latest edition of ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."

2.4 ACCESSORIES

A. Control equipment and sequence of operation are given in the mechanical schedule and control notes on the mechanical plan drawing.

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Provide common alarm dry contact for BMS interface.

D. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection, including auto setting.

E. Automatic-reset timer to prevent rapid cycling of compressor.

F. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

1. Minimum Insulation Thickness: 1 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb. Coordinate installation of units with architectural, mechanical and electrical work.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounting, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit. Retain paragraph above or first paragraph below.

D. Install ground-mounting, compressor-condenser components on polyethylene mounting base.

E. Install roof-mounting compressor-condenser components on equipment supports. Anchor units to supports with removable, cadmium-plated fasteners.

F. Install seismic restraints.

G. 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 Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Water Coil Connections: Comply with requirements in Division 15 Section "Hydronic Piping." Connect to supply and return coil with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
2. Connect refrigerant pipes with all accessories listed above. Comply with requirements in Division 15 Section "Refrigerant Piping." Refrigerant piping is limited to 100-150 ft.

B. Install piping adjacent to unit to allow service and maintenance.

C. Ground equipment according to Electrical Specification Section for "Grounding and Bonding for Electrical Systems."

D. Electrical Connections: Comply with requirements in Electrical Specification Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

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.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 15760

UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Cabinet unit heaters with centrifugal fans and hot-water coils.
2. Propeller unit heaters with hot-water coils.
3. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.
4. Infrared, electric heaters.
5. Toe space heaters with fans and electric resistance heating coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, dimensions, materials, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Details of anchorages and attachments to structure and to supported equipment.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of piping valves and specialties.

6. Location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which unit heaters will be attached.
2. Perimeter moldings for exposed cabinets.

D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

E. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in the latest edition of ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Latest Edition Compliance: Applicable requirements in the latest edition of ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 ELECTRIC WALL HEATERS

A. Manufacturers:

1. Trane.
2. Indeeco.
3. Berko Electric Heating; a division of Marley Engineered Products.

B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

C. Cabinet:

1. Front Panel: Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest edition of ASHRAE 62.1.

D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection.

F. Fan: Aluminum propeller directly connected to motor.

1. Motor: Permanently lubricated. Comply with requirements in Division 15 Section "Common Motor Requirements for HVAC Equipment."

G. Controls: Unit-mounted thermostat.

H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

I. Capacities and Characteristics: As scheduled on drawings

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof.

B. Install cabinet unit heaters to comply with NFPA 90A. Coordinate to assure correct size openings for recessed units.

C. After construction, including painting is completed, clean exposed surfaces of units.

D. Touch-ups marred or scratched surfaces of factory finished cabinets, using finish materials furnished by the manufacturer.

3.3 CONNECTIONS

A. Comply with safety requirements in UL 1995.

B. Ground equipment according to electrical specification for "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to electrical specification for "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION

SECTION 15800

ODOR CONTROL DUCTWORK

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of odor control ductwork at the Headworks.

B. Install all ducts in the general locations shown on the drawing(s) but conform to all structural and finish conditions of the structure. Before fabricating any ductwork, Contractor shall check the physical conditions at the job site and make all necessary changes in cross sections, offsets and similar items, whether they are specifically indicated on drawings or not.

1.2 SUBMITTALS

A. Contractor shall provide all submittals in accordance with the requirements of Section 01300, Submittals, and Section 01340, Shop Drawings, Product Data and Samples.

B. Submit complete descriptive product data for all equipment to be provided, including but not limited to, fabrication and installation drawings, pertinent design calculations, and any other related information necessary to facilitate Owner and Engineer review.

C. Operation and Maintenance Manuals. Provide complete operation and maintenance manuals for all equipment, in accordance with the requirements of Section 01730, Operation and Maintenance Data.

1.3 WARRANTY

A. Provide equipment warranty in accordance with the requirements of Section 01700, Contract Closeout.

1.4 STANDARDS AND CODES

A. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA HVAC Duct Construction Standards, metal and flexible in all pressure ranges. Fiberglass ductwork material and installation shall comply with the latest edition of SMACNA Fibrous Glass Duct Construction Standards. All air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA manual.

B. Construct ductwork and all air distribution devices to NFPA 90A, NFPA 90B and NFPA 91 standards.

1.5 DEFINITIONS

A. Duct Size. The round duct sizes shown are nominal dimensions.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Acceptable manufacturers for odor control ductwork shall include the following:

1. Fab-Tech, Inc.,

2. Perry Fiberglass Products, Inc.,
3. Spunstrand, Inc.,
4. or Approved Equal.

2.2 DUCT MATERIAL

A. General. Noncombustible or conforming to requirements for Class I air duct materials or UL 181.

B. Steel Ducts. All steel ducts shall be 316L stainless steel, Schedule 10.

C. FRP Ducts. All FRP ducts shall be corrosion resistant with Bisphenol A Epoxy Vinyl Ester Resin.

D. Steel Fasteners. Rivets, bolts or sheet metal screws. All items used for fasteners shall be 316 stainless steel.

E. Sealant. Nonhardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic, gasket.

2.3 DUCTWORK

A. Fabricate and support in accordance with the latest edition of SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing and sealing for minimum operating pressures indicated.

B. Anticipated duct pressure rating to be approximately 2" water column. Contractor to verify final fan submittal to determine exact duct pressure rating required based on fan total static pressure.

C. Construct tees, bends and elbows with radius of not less than 1-1/2 times the width of duct on centerline.

D. For round and oval duct, provide the elbows with a centerline radius of 1-1/2 times the duct diameter or duct width. For round ducts, furnish smooth elbows or 5-piece, 90-degree elbows and 3-piece, 45-degree elbows.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

F. Provide damper where shown on the drawings. Contractor to provide equal air flow balancing to each of the four locations during odor control startup and lock nut dampers in the balanced condition.

G. Slope ductwork away from the odor control unit, downward sloping to dumpster odor control piping, as indicated on the drawings and include drain port in bottom of ductwork at all low points.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Construction Standards. Use construction methods which follow the requirements outlined in this specification, as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in these specifications or accompanying drawings.

B. Wall Penetrations. At all locations where ductwork passes through slabs, provide watertight sleeves projecting 3 inches above finished floor. Fabricate sleeves of stainless steel. Anchor into slab as required.

C. Coating. Coat ductwork with gel coat and UV inhibitor. Installation shall follow all requirements in Specification Section 09928 – Protective Coatings for Wastewater Systems.

3.2 DUCTWORK

A. Construction. Construct ducts in accordance with the SMACNA HVAC Duct Construction Standards Manual.

B. Obstruction. Install streamline deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.

C. Duct Supports. Support odor control ductwork in accordance with the drawings.

END OF SECTION

SECTION 15820

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft dampers.
2. Combination louver/damper assemblies.
3. Duct accessory hardware.

1.3 SUBMITTALS

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

1. For all accessories specified, include construction details, dimensions, materials, finishes, bearings and compliance with applicable codes.
2. Performance: Show compliance with pressure drops or specific requirements noted.
3. Provide manufacturer's installation instructions.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and. Include dimensions, weights, loads, and required clearances; and method of field. Include the following:

a. Control damper installations.
b. Wiring Diagrams: For power, signal, and control wiring.

C. Source quality-control reports.

D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the schedule in PART 3.

D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation
2. Ruskin Company.
3. Tamco.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm

D. Maximum System Pressure: 1-inch wg.

E. Frame: 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum, with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl or neoprene, mechanically locked

I. Blade Axles:

1. Material: Stainless steel or aluminum.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.

    a. Sleeve Thickness: 20-gage minimum.
    b. Sleeve Length: 6 inches minimum.

6. Screen Mounting: Rear mounted.
7. Screen Material: Aluminum.
8. Screen Type: Insect.
9. 90-degree stops.

2.3 COMINATION LOUVER/DAMPER ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ruskin Company.

B. Design

1. Louver shall include a drainable stationary louver blade section and an integral low leak adjustable airfoil blade control damper within a 6 inch frame. Design incorporates visible mullions or frames at the perimeter of the louver and also at certain intervals within the louver perimeter to support the louver blades. Louver blade sightlines are interrupted at the mullion locations. No rear-mounted blade

supports are visible from front. Gutter drain in head frame and each blade. Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade. Steeply angled integral sill eliminating areas of standing or trapped moisture.

2. Louver shall be Texas Department of Insurance (TDI) listed.

C. Frames

1. Frame Depth: 6 inches.
2. Material: Extruded aluminum, Alloy 6063-T6.
3. Wall Thickness: 0.125 inch, nominal.

D. Front Blades

1. Style: Drainable 37.5 degree angle on 6-1/8 centers.
2. Material: Extruded aluminum, Alloy 6063-T6.
3. Wall Thickness: 0.081 inch, nominal.

E. Rear Blades

1. Style: Airfoil shape, adjustable.
2. Material: Extruded aluminum, Alloy 6063-T6.
3. Wall Thickness: 0.070 inch double wall, nominal, for single section widths through 60 inches.

F. Seals

1. Provide blade and jamb seals. Extruded vinyl blade edge seals and flexible, compressible aluminum jamb seals allowing less than 3 cfm/sf at 1 inch w.g. pressure differential.

G. Linkage

1. Side linkage, out of airstream (concealed in frame).

H. Blade Axles

1. 7/16-inch- diameter; in. dia. plated steel hex.
2. Operating Temperature Range: From minus 20 to plus 180 deg F.

I. Bearings

1. Stainless steel sleeve pressed into frame.

J. Insect Screen

1. Aluminum: 18-16 mesh, mill finish, 0.011 inch wire.
2. Frame: Aluminum.

K. Finish

1. AAMA 2605 2-coat factory-painted finish with 20-year warranty. Color shall be Portland Stone by manufacturer.

2.4 DUCT ACCESSORY HARDWARE

A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Set dampers to fully open position before testing, adjusting, and balancing.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

END OF SECTION

SECTION 15830

AXIAL HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements Division 01, Division 15 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Sidewall propeller fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions clearly plotted and including:

   a. Sound power levels for both fan inlets and outlet at rated capacity.
   b. Manufacturer's data for adjustable fan blades for at least five (5) blade settings, including maximum.
   c. Minimum "turn down" CFM for controllable pitch fans.

2. Certified fan sound power ratings, including:
   a. Fan manufacturer's published sound power, level data based on actual test, on the fan sizes being furnished, conducted in accordance with current AMCA standards. Such data is to define sound power levels (PWL) re: 10-12 watts for each of the eights (8) frequency bands.
   b. Manufacturer's estimated data will not be acceptable.

3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field quality-control test reports.

E. Operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final locations, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Protect motors, shafts, and bearings from weather and construction dust. Comply with manufacturer’s wheel and motor rotation schedule for extended storage.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

PART 2 - PRODUCTS

2.1 SIDEWALL PROPELLER FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck.
2. Loren Cook company.
3. Howden Buffalo, Inc.

B. Description: Fan wheel and housing, straightening vane section, factory-mounted motor with belt drive, and accessories.

C. Housings: Steel.

1. Inlet and Outlet Connections: Outer mounting frame and companion flanges.
2. Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.
3. Mixed-Flow Outlet Connection: One flanged discharge(s) perpendicular to fan inlet.

D. Wheel Assemblies: Cast aluminum with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.

E. Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.2.
2. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
3. Fan Pulleys: Cast iron 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 larger motors. 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. Motor Mount: Adjustable base.
7. Shaft Bearings: Radial, heavy duty, pillow block type, self-aligning ball or roller bearings.

    a. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.
    b. Roller-Bearing Rating Life: ABMA 11, L10 of 100,000 hours.
    c. Extend lubrication lines to outside of casing and terminate with grease fittings.

F. Accessories:

1. Mounting Clips: Horizontal ceiling clips welded to fan housing, of same material as housing.
2. Inlet and Outlet Screens: Wire-mesh screen on fans not connected to ductwork of same material as housing.
3. Backdraft Dampers: Low leakage type for mounting with flexible connection to the discharge of fan or direct mounted to the discharge diffuser section of same material as housing.
4. Motor Cover: Cover with side vents to dissipate motor heat, of same material as housing.

G. Motors: Comply with requirements in Division 15 Section "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally enclosed, fan cooled.
2. Direct-Driven Units: Encase motor in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.

H. Factory Finishes:

1. Sheet Metal Parts: Prime coat before final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.
3. Coatings: Powder-baked enamel;.

a. Apply to finished housings.
b. Apply to fan wheels.

2.2 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install axial fans level and plumb.

B. Install units with clearances for service and maintenance.

C. Label fans according to requirements specified in Division 15 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Ground equipment according to electrical specification for "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to electrical specification for "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. 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.
5. Adjust damper linkages for proper damper operation.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
8. 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.
9. Shut unit down and reconnect automatic temperature-control operators.
10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Lubricate bearings.

END OF SECTION

SECTION 16050

ELECTRICAL GENERAL PROVISIONS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of all labor, materials and equipment required for complete and functioning electrical systems as required by the contract documents.

A. New Work. The work includes, but is not limited to, the following principal systems and equipment:

1. 480 volt distribution.
2. 208/120 volt distribution.
3. Raceway systems for power, process control, and all special systems cables.
4. Low voltage motor control.
5. Motor Control Center
6. Distribution panels.
7. Panelboards.
8. Dry type transformers.
9. Lighting fixtures, poles.

1.2 APPLICABLE PROVISIONS

A. Provisions Specified Elsewhere. Unless modified in this section, General and Supplementary General Conditions, applicable provisions of Division 1 - General and other provisions of contract documents apply to work of Division 16 - Electrical.

B. Application. Provisions of this section apply to every section of Division 16 - Electrical, except where specifically modified.

1.3 REFERENCE CODES AND STANDARDS

Standards of the following organizations may be referenced in the specification. Unless noted otherwise, references are to standards or codes current at the time of bidding.

A. Association of Edison Illuminating Companies (AEIC).

B. American National Standards Institute (ANSI).

C. Institute of Electrical and Electronics Engineers (IEEE).

D. Insulated Cable Engineers Association (ICEA).

E. National Electrical Code (NEC).

F. National Electrical Contractors Association (NECA).

G. National Electrical Manufacturers Association (NEMA).

H. National Electrical Safety Code (NESC).

I. National Electrical Testing Association (NETA).

J. National Fire Protection Association (NFPA).

K. Underwriters' Laboratories (UL).

1.4 REGULATIONS AND PERMITS

A. Regulations. Work, materials and equipment must comply with the latest rules and regulations of the following:

1. National Electrical Code (NEC).
2. National Electrical Safety Code (NESC).
3. Occupational Safety and Health Act (OSHA).
4. Americans with Disabilities Act (ADA).
5. Local, state and federal codes, ordinances and regulations.

B. Discrepancies. The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's representative in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

C. Permits. Obtain certificates of inspection and other permits required as a part of the work.

1.5 CONTRACT DRAWINGS

A. Intent. The intent of the drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system. Electrical drawings are generally diagrammatic and show approximate location and extent of work. Install the work complete, including minor details necessary to perform the function indicated. In case of doubt as to work intended, or if amplification or clarification is needed, request instructions from the Owner's representative.

B. Discrepancies. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Owner's representative for his interpretation.

C. Outlet and Equipment Locations. Coordinate the actual locations of electrical outlets and equipment with building features and equipment as indicated on architectural, structural, mechanical and plumbing drawings. Review with the Owner's representative any proposed changes in outlet or equipment location. Relocation of outlets before installation, of up to 5 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location, when so requested by the Owner's representative.

1.6 CONTRACTOR QUALIFICATIONS

An acceptable Contractor for the work under this division must have personnel with experience, training and skill to provide a practical working system. The Contractor may be required to furnish acceptable evidence of having installed not less than three systems of size and type comparable to this project. The systems must have served satisfactorily for not less than 3 years. The superintendent must have had experience in installing not less than three such systems.

PART 2 - P R O D U C T S

2.1 PRODUCT REQUIREMENTS

A. Condition. Provide new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of product specified.

B. NEC and UL. Products must conform to requirements of the National Electrical Code. Where Underwriters' Laboratories have set standards, listed products and issued labels, products used must be listed and labeled by UL.

C. Space Limitations. Equipment selected must conform to the building features and must be coordinated with them. Do not provide equipment which will not suit arrangement and space limitations.

D. Factory Finish. Equipment must be delivered with a hard surface, factory-applied finish so that no additional field painting is required except for touch-up as required.

2.2 SUBSTITUTIONS

Refer to Section 01610, Product Requirements.

PART 3 - E X E C U T I O N

3.1 PROTECTION OF EQUIPMENT

A. Moisture. During construction, protect switchgear, transformers, motors, control equipment, and other items from insulation moisture absorption and metallic component corrosion by appropriate use of strip heaters, lamps or other suitable means. Apply protection immediately on receiving the products and maintain continually.

B. Clean. Keep products clean by elevating above ground or floor and by using suitable coverings.

C. Damage. Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.

D. Finish. Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore any finishes that become stained or damaged.

3.2 INSTALLATION

A. Cooperation with Other Trades. Cooperation with trades of adjacent, related or affected materials or operations, and of trades performing continuations of this work under subsequent contracts, is considered a part of this work in order to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades.

B. Workmanship. Work must be performed by workmen skilled in their trade. The installation must be complete. Provide work in accordance with NECA 1.

C. Concrete Equipment Pads. Install 4-inch-thick concrete foundation pads for indoor floor-mounted equipment, except where direct floor mounting is required. Pour pads on roughened floor slabs, sized so that outer edges extend a minimum of 3 inches beyond equipment. Trowel pads smooth and chamfer edges to a 1-inch bevel. Secure equipment to pads as recommended by the manufacturer.

D. Setting of Equipment. Equipment must be leveled and set plumb. Sheet metal enclosures mounted against a wall must be separated from the wall not less than 1/4 inch by means of corrosion-resistant spacers or by 3 inches of air for freestanding units. Use corrosion-resistant bolts, nuts and washers to anchor equipment. In sufficient time to be coordinated with work under other divisions, provide drawings and layout work showing exact size and location of sleeves, openings or inserts for electrical equipment in slabs, walls, partitions and chases.

E. Sealing of Equipment.

1. Voids between sleeves or core-drilled holes and pipe passing through fire-rated assemblies shall be firestopped to meet the requirements of ASTM E 814, in accordance with Section 07840, Firestopping. Contractors shall provide proper sizing when providing sleeves or core-drilled holes to accommodate their through-penetrating items.
2. Seal openings into equipment to prevent entrance of animals, birds and insects.

F. Motors.

1. Motors are specified under other sections of Division 16.
2. Electrical work includes the electrical connection of all motors, except those which are wired as a part of equipment.

G. Concealed Work. Conceal all electrical work in walls, floors, chases, under floors, underground and above ceilings except:

1. Where shown or specified to be exposed. Exposed is understood to mean open to view.
2. Where exposure is necessary to the proper function.
3. Where size of materials and equipment preclude concealment.

H. Application. Unless otherwise indicated, power will be utilized as follows:

1. 208 or 480 volts, three phase: motors above 1hp.
2. 120 volts, single phase: motors 3/4 horsepower and smaller.
3. 120 volts, or 277 volts, single phase: LED lighting.
4. 120 volts, single phase: incandescent lighting.
5. 120 volts, single phase: fluorescent lighting.
6. 120, 208 or 480 volts, single phase: high-intensity-discharge lighting.
7. 120 volts, single phase: convenience outlets.

I. Transformers. Use transformers to change the service to the required utilization voltages.

J. Load Balancing. All loads must be balanced with no phase load being more than 10% of another.

3.3 TESTING

A. Test Conditions. Place circuits and equipment into service under normal conditions, collectively and separately, as may be necessary to determine satisfactory operation. Perform specified tests in the presence of the Owner's representative. Furnish all instruments, wiring, equipment and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the drawings and specifications. Special tests on certain items are specified hereinafter. Where specified that the testing be performed by an independent testing company, an Owner approved NETA certified testing company shall be used.

B. Test Dates. Schedule final acceptance tests sufficiently in advance of the contract date to permit completion of any necessary adjustment or alterations within the number of days allotted for completion of the contract.

C. Retests. Conduct retests as directed by the Owner's representative of such time duration as may be necessary to assure proper functioning of adjusted or altered parts or items of equipment. Any resultant delay as a result of such necessary retests does not relieve the Contractor of his responsibility under this contract.

END OF SECTION

SECTION 16051

ACCEPTANCE TESTING AND CALIBRATION

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section provides the guidelines for testing of electrical equipment, low voltage cable, protective relays, circuit breakers, motor control centers, motors, and related apparatus to be used for the site interior and exterior electrical distribution system. This specification does not release the CONTRACTOR or vendor from any further testing required for safe commissioning of the equipment.

1.2 QUALITY ASSURANCE

National Electric Testing Association Standards for acceptance testing of Electrical Distribution Apparatus, Publication 2.001, and IEEE Publication No. 141, are hereby made a part of this section, unless otherwise modified herein.

1.3 TESTS

A. All tests, other than Low Voltage Systems and Equipment, will be supervised by the OWNER. THE CONTRACTOR will give a one-week notice of all scheduled tests to the OWNER in writing. If a third party is conducting the tests, the CONTRACTOR's presence will be required also.

B. Provide tests as required by specific sections of these Division 16 specifications. Review Division 16 requirements for other testing not specifically mention in this section.

C. Under this specification the CONTRACTOR shall perform the electrical tests on the following equipment and as specified under Part 3, Execution. The CONTRACTOR will supply all equipment required to perform all testing responsibilities.

1. All transformers.
2. Low voltage cable.
3. Motors.
4. All controls for miscellaneous motors.
5. Motor control centers.
6. Grounding.

D. The Contractor will notify the Owner of scheduled dates of electrical equipment installation completion. Equipment testing will be coordinated at this time by Contractor with Owner and appropriate Manufacturer's Representatives.

PART 2 - P R O D U C T S

Not used.

PART 3 - E X E C U T I O N

3.1 PREPARATORY WORK

Prior to the testing of any specific piece of equipment, the Contractor will remove all shipping hardware and inspect for broken or missing parts and proper connections in accordance with the manufacturer's instructions.

3.2 MOTOR STARTERS

A. Test, adjust, and clean motor starters as required by design specifications and manufacturer's published instructions.

B. Record all nameplate data on starters and motors and information on components such as fuses, current transformer ratios, overload relays, and settings. Test ground fault relays.

C. Check all connections for tightness. Check all contacts for proper alignment and pressure. Verify that all movable parts are free to operate.

D. Take insulation resistance readings of components using 1,000-volt megger for equipment rated 440 to 600 volts. Investigate and correct the causes if an insulation resistance less than one megohm is noted.

E. Check the starter control sequence by using a source of control voltage, and dropping it through each of its protective devices, interlocks, pushbuttons, etc.

F. Check all fuses for continuity and proper rating.

G. Verify that all secondary circuits of current transformers are connected.

H. Check all space heaters and related circuitry.

3.3 MOTOR CONTROL CENTERS

A. Visually inspect the centers externally and internally (bus-bracing, loosened frame bolts, etc.) for damage or possible trouble before making any tests. Wipe clean the center of all construction dirt and dust.

B. With all the starters open, including the main, megger the bus, phase-to-phase and phase-to-ground using a 500V megger.

C. Confirm starter heater size with actual full load current of corresponding motors.

D. Before motors are run for plant start-up, megger motor cables with a 500V megger with the motor connected. Jog the motor to determine correct rotation and after rotating is confirmed correct, set the motor circuit protector breakers per manufacturers recommended procedure.

E. With motor overloads removed, confirm proper operation of a motor control circuit, including all start and stop permissive, interlocks, and trip functions.

3.4 GENERAL

Submit directly to the ENGINEER six (6) copies of all test reports certified by the testing technician.

END OF SECTION

11000-B – MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No.: _____ Specification Section: _____

Equipment Name: _____

Contractor: _____

Manufacturers of an equipment item: _____

The undersigned manufacturer certifies that a service ENGINEER has instructed the wastewater treatment operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)

Start-up procedure reviewed

Shutdown procedure reviewed

Normal operation procedure reviewed

Others:

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency)

Described special tools required

Described normal items to be reviewed for wear

Described preventive maintenance instructions

Described greasing frequency

Others:

Date: _____ Manufacturer: _____

Signature of Authorized Representative

Date: _____ _____

Signature of Owner's Representative

Date: _____ _____

Signature of Contractor's Representative

11000-A – MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No.:_____ Specification Section:_____

Equipment Name:_____

Contractor: _____

Manufacturer of equipment item:_____

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations and that the trial operation of the equipment item has been satisfactory.

Comments: _____

Date: _____ Manufacturer: _____

Signature of Authorized Representative: _____

Date: _____ Contractor: _____

Signature of Authorized Representative: _____

TRANSFORMER TEST REPORT

PROJECT NO.: _____

OWNER: _____

CONTRACTOR: _____

ENGINEER: _____

PROJECT: _____

REFERENCE DATA:

Report No. _____ Description: _____

Specification Section No. _____ Page No. _____ Paragraph No. _____

Sheet No. _____ Entitled _____

Detail Designation _____ Drawing Attached (Y/N) _____

EQUIPMENT IDENTIFICATION:

Name (From Drawings) _____

Identification No. _____ Unit No. _____

Manufacturer _____

Model No. _____ Serial No. _____

LOCATION: Structure _____

N/S Coord. _____ E/W Coord. _____ Station _____ Elev. _____

RESISTANCE TESTER

Mfgr. _____ Model No. _____ Serial No. _____

Range _____ Megohms _____ Max Voltage _____ vdc

WEATHER _____ °F _____ % RH DATE _____

KVA _____ PHASE _____

PRIMARY VOLTAGE _____ SECONDARY VOLTAGE _____

Primary Insulation Resistance (Megahoms after 15 sec.)			Secondary Insulation Resistance (Megahoms after 15 sec.)		
Phase A	Phase B	Phase C	Phase A	Phase B	Phase C

Test by: _____

Witness by: _____

Test by: _____

Witness by: _____

END OF SECTION

SECTION 16052

IDENTIFICATIONS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision and installation of tags/nameplates on all equipment, devices, instruments, conduit, and conductor marked as indicated on the drawings and as specified herein. Major equipment shall be furnished with nameplates in accordance with their individual specifications.

PART 2 - P R O D U C T S

2.1 EQUIPMENT AND DEVICE MARKING

A. Designations. Identify all equipment, devices, feeders, branch circuits and similar items with the same designations as indicated on the contract documents.

B. Nameplates. Externally mark all electrical equipment with nameplates identifying each and the equipment served. Nameplates shall be black laminated rigid phenolic with white core. Nameplate minimum size shall be 1 inch high by 3 inches long with 3/16-inch-high engraved white letters. Supply blank nameplates for spare units and spaces.

C. Nameplate Fasteners. Fasten nameplates to the front of equipment only by means of stainless steel self-taping screws. Stick-ons or adhesives will not be allowed unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.

D. Nameplate Information. In general, the following information is to be provided for the types of electrical equipment as listed.

1. Motor Control Centers. On the mains identify the piece of equipment, the source and voltage characteristics (i.e., 480/277V 3PH 4W). For each branch circuit protective device, identify the load served.
2. Transformers, Individual Starters, Contactors, Disconnect Switches, Transfer Switches and similar equipment. Identify the device designation, source and load served.
3. Panelboards. Identify the source, panelboard designation and voltage characteristics.

E. Panelboards. Prepare a neatly typed circuit directory behind clear heat-resistant plastic in a metal frame attached to the inside of the door for each panelboard. Identify circuits by equipment served and by room numbers where room numbers exist. Indicate spares and spaces with light, erasable pencil marking. Adhesive mounted directory pocket is not acceptable.

F. Pull, Junction and Outlet Boxes. With 1/2-inch-high lettering, identify conduits connected to pull, junction and outlet boxes with the complete circuit number of the conductors contained therein. Where multiple circuits are contained in a box, identify the circuit conductors with permanent tags which indicate circuit designation.

G. Power Receptacles. Use nameplate or engrave device plate to identify power receptacles where the nominal voltage between any pair of contacts is greater than 150 volts with circuit number, voltage and phases. If nameplates are used, attach to wall directly above device plate.

I. Wall Switches. Where the equipment served is not in sight of the wall switch, provide an engraved switch plate or attach a nameplate to the wall directly above the switch.

2.2 CONDUCTORS IDENTIFICATION SYSTEM

A. Provide heat-shrink wire markers, or approved equal, for conductor identification.

B. Provide complete power and control conductor identification system so that after installation circuits can be easily traced from origin to final destination.

C. Identify power and control conductors at each termination and in all accessible locations such as manholes, handholes, panels, switchboards, pull boxes, terminal boxes, etc. For identification, use type of tags specified herein.

D. Tag conductors using a three-segment conductor numbering scheme which defines the origin of the conductor, the function of the conductor, and the destination of the conductor.

E. Example: MCC-A-A1-AIR where MCC-A, Cubicle A1 is the origin.

F. Make the origin and destination identification the specific names for the equipment used in the Contract Documents.

2.3 CONDUIT MARKERS

Conduit markers shall be the metal type permitting embossing on the job.

2.4 POWER OUTLETS, SWITCHES, AND PILOT DEVICES

A. Mark power outlets with voltage, phase, and circuit number.

B. Identify all wall switches, disconnect switches, etc., with name tags and circuits served.

C. Identify all pushbutton stations with their functions and equipment served.

2.5 EXPOSED CONDUITS AND CABLES ON CABLE TRAY

Identify all exposed conduits and cables by their circuit numbers or loop numbers at the source, at the equipment, and at 20 feet spans in between.

PART 3 - E X E C U T I O N

3.1 CONDUIT MARKERS

A. Exposed Conduits.

1. Furnish conduit markers at the point of origin, point of termination upon crossing on each side, and at 50-foot intervals for all exposed and accessible conduits.
2. Install markers lengthwise and attach with cable ties.
3. Stencil high voltage conduit with the legend "high voltage" stenciled in minimum 1-inch high red letters.

B. Underground Conduit Duct Banks.

1. Mark underground ductbanks with Underground-Line Warning Tape: Bury nonconducting underground line warning tape no less than 12 inches above all concrete-encased duct and duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of ductbank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

2. Underground-Line Warning Tape:

a. Tape:

1) Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines. Printing on tape shall be permanent and shall not be damaged by burial operations.

2) Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

b. Color and Printing:

1) Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.

2) Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".

3) Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

c. Tag: Type I:

1) Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

2) Width: 3 inches.

3) Thickness: 4 mils.

4) Weight: 18.5 lb/1000 sq. ft

3.2 CONDUCTORS

Tag all conductors at their origin, termination, pullboxes and junction boxes.

3.3 NAMEPLATES/TAGS

A. Furnish and install nameplates for all panelboards, motor starters, motor control centers, disconnect switches, instrument panels, dry-type transformers, and control stations.

B. Engrave the equipment designation, on nameplates. All switches, indicating lights, pushbuttons, meters, and parameter indicators on panels shall be clearly identified with its function or tag, as required.

C. Stainless steel tags shall be used on instrument, motors, and other devices, as applicable. The tags shall be affixed to the instrument with drive pins or stainless-steel wire in such manner that it does not need to be removed to install the instrument. Motors shall carry the tag assigned to its driven equipment, i.e., P-101.

END OF SECTION

SECTION 16054

ENGINEER'S POWER SYSTEM STUDIES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

B. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.1 ACTION SUBMITTALS

A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
   a. Coordination-study input data, including completed computer program input data sheets.
   b. Study and equipment evaluation reports.
   c. Arc-flash study input data, including completed computer program input data sheets.
   d. Requiring submittal of the following arc-flash analysis does not relieve Engineer from responsibility for a preliminary study to ensure that system overcurrent protection can withstand the fault current at its location to protect personnel and equipment. This submittal confirms that actual equipment in use, along with types and lengths of cables that will be installed, perform as system was designed.
   e. Arc-flash and Coordination study report; signed, dated, and sealed by Power Systems Analysis Specialist.
   f. Submittal of the report prior to final approval of equipment requires some level of confidence that equipment will be approved, because the purpose of this study submittal is to confirm that coordination of exact equipment to be installed meets requirements. There is a balancing act of early submission of the study so equipment can be ordered, and the risk that equipment the study is based on will not be approved.
3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

4. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

   a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.2 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power System Analysis Software Developer.
2. For Power Systems Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates:
1. For overcurrent protective device coordination study software, certifying compliance with IEEE 399.
2. For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Responsible Party: Same manufacturer as Section 16455 Motor Control Centers.

E. Power System Analysis Software Qualifications:

1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

F. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

G. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - P R O D U C T S

2.1 COORDINATION STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.

2. Conductor types, sizes, and lengths.

3. Transformer kilovolt ampere (kVA) and voltage ratings.

4. Motor and generator designations and kVA ratings.

5. Switchgear, switchboard, motor-control center, and panelboard designations.

6. Any revisions to electrical equipment required by the study.

7. Study Input Data

D. Protective Device Coordination Study:

E. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

1. Phase and Ground Relays:

a. Device tag.

b. Relay current transformer ratio and tap, time dial, and instantaneous pickup value.

c. Recommendations on improved relaying systems, if applicable.

2. Circuit Breakers:

a. Adjustable pickups and time delays (long time, short time, and ground).

b. Adjustable time-current characteristic.

c. Adjustable instantaneous pickup.

d. Recommendations on improved trip systems, if applicable.

3. Fuses: Show current rating, voltage, and class.

F. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.

2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

4. Plot the following listed characteristic curves, as applicable:

   a. Power utility's overcurrent protective device.

   b. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

   c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.

   d. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.

   e. Ground-fault protective devices.

   f. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Maintain selectivity for tripping currents caused by overloads.

6. Provide adequate time margins between device characteristics such that selective operation is achieved.

7. Comments and recommendations for system improvements.

2.3 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.

2. Conductor types, sizes, and lengths.

3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.

4. Motor and generator designations and kVA ratings.

5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

G. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.

e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.

2. Protective device clearing time.

3. Duration of arc.

4. Arc-flash boundary.

5. Restricted approach boundary.

6. Limited approach boundary.

7. Working distance.

8. Incident energy.

9. Hazard risk category.

10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.4 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 16052 "Identification" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.

B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.
    a. Arc-flash boundary.
    b. Restricted approach boundary.
    c. Limited approach boundary.
4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.
9. Labels shall be machine printed, with no field-applied markings.

PART 3 - E X E C U T I O N

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.

2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

3.3 COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.

b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.

2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.

K. Include the ac fault-current decay from induction motors and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.

2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

3. Include in the report identification of any protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.

2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.

3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.

3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.

4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.

D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.

F. Calculate the limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors shall not be considered beyond three to five cycles.

H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.

2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.6 LABELING

A. Apply one arc-flash label on the front cover [of each section of the equipment] [and on side or rear covers with accessible live parts and hinged doors or removable plates] for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below shall have an arc-flash label applied to it:

1. Motor-control center.

2. Low-voltage switchboard.

3. Switchgear.

4. Medium-voltage switch.

5. Medium voltage transformers

6. Low voltage transfomers

7. Panelboard and safety switch over 250 V.

8. Applicable panelboard and safety switch under 250 V.

9. Control panel.

C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.

2. Indicate protection level required.

3.7 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.8 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION

SECTION 16060

GROUNDING

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section specifies the furnishing and installation of grounding and bonding equipment for electrical systems.

1.2 REFERENCE STANDARDS

Design, test, assemble and install in conformance to the latest edition of the following applicable industry standards.

A. ANSI/IEEE Std 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

B. ANSI/UL 467 - Grounding and Bonding Equipment.

1.3 SUBMITTALS

Submit product data.

PART 2 - P R O D U C T S

2.1 GROUND RODS

A. Materials. Provide 3/4-inch by 10-foot long, copper-clad, steel grounding electrodes. Supply a rod to which the copper cladding is permanently and inseparably bonded to a high-strength steel core.

B. Listing. UL 467.

2.2 CONNECTIONS

A. Materials. Provide exothermic welded type connections for all grounding and bonding connections. Obtain written permission from the Engineer for the use of non-exothermic connections.

B. Listing. UL 467.

2.3 WIRING

A. Grounding Electrode Conductors. Bare tinned-copper conductors, minimum size of #4/0 AWG, stranded.

B. Equipment Grounding Conductors. Provide bare tinned-copper conductors for bonding jumpers. Provide 600-volt insulated stranded copper conductors having a green-colored insulation for equipment grounding conductors.

C. Listing. UL 83.

2.4 GROUND BUS

Where a field-provided ground bus is required, use round-edge copper bar with 98 percent International Annealed Copper Standard (IACS) conductivity. Size the bus for not less than 25 percent of the cross-sectional area of the related feeder. A minimum size of 1/4 inch by 2 inches is required.

PART 3 - E X E C U T I O N

3.1 SYSTEM GROUND

A. System Neutral. Where a system neutral is used, ground the system neutral as required by NEC Article 250. Ground the system neutral only at the point of service and isolate it from ground at all other points in the system.

B. Separately Derived Systems. Solidly ground neutrals of separately derived systems such as transformers, etc., in accordance with NEC 250-30, whether neutrals are actually installed or not.

C. Size. Size the system grounding electrode conductors to comply with NEC Table 250-66, unless shown larger.

D. Testing. Test the completed grounding system. If the resistance of the grounding system is greater than 5 ohms, add ground rods to attain 5 ohms.

3.2 EQUIPMENT GROUND

A. Raceway Systems and Equipment Enclosures.

1. Ground cabinets, junction boxes, outlet boxes, motors, controllers, raceways, fittings, switchgear, transformer enclosures, other electrical equipment and metallic enclosures. Ground equipment and enclosures to the continuous-grounded, metallic raceway system in addition to any other specific grounding shown.
2. Provide bonding jumpers and ground wire throughout to ensure electrical continuity of the grounding system.
3. Provide grounding-type insulated bushings for metal conduits 1-1/2 inches and larger terminating in equipment enclosures containing a ground bus and connect the bushing to the ground bus.
4. Provide a green insulated equipment grounding conductor for each feeder and branch circuit.

B. Size. When grounding and bonding conductors are not sized on drawings, size the grounding conductors in accordance with NEC Table 250-66. Size bonding jumper so that minimum cross-sectional area is greater than or equal to that of the equivalent grounding conductor as determined from NEC Table 250-102(C)(1).

END OF SECTION

SECTION 16120

INSULATED CONDUCTORS

PART 1 - G E N E R A L

1.1 SUMMARY

Provide insulated conductors.

1.2 REFERENCE STANDARDS

A. ANSI/IEEE 386 - Separable Insulated Connectors for Power Distribution Systems Above 600 Volts.

B. ANSI/UL 4 - Armored Cable.

C. ANSI/UL 83 - Thermoplastic-Insulated Wires and Cables.

D. ANSI/UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

E. IEEE No. 48 - Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations.

F. ICEA S-61-402 (NEMA WC 5) - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

G. ICEA S-68-516 (NEMA WC 8) - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.3 SUBMITTALS

A. Provide product data on the following:

1. 600-volt conductor, splicing and terminating materials.

PART 2 - P R O D U C T S

2.1 IDENTIFICATION

Provide new insulated conductors marked according to NEC Article 310.

2.2 600-VOLT INSULATED CONDUCTORS

A. Size. As shown.

B. Construction.

1. Conductor. Soft-drawn, annealed copper. Stranded for No. 16 AWG and larger.
2. Insulation.
   a. Unless otherwise noted on the drawings, use THWN for general wiring.

b. Use Type shielded VFD 90ºC copper cable for load-side power cable routed between motor controllers (including variable frequency and soft start controllers) and motors where greater than 25 horsepower and not integrally furnished with motor (i.e. submersible pump motors).

C. Usage.

1. For general wiring use No. 12 minimum.
2. For field-installed control wiring use No. 14 or larger stranded conductors.
3. For tray cable (Type TC) provide a multi-conductor cable consisting of insulated conductors as described in the preceding paragraph with an overall outer sheath. Use a nonmetallic sheath that is moisture, sunlight and corrosion resistant and flame retardant, specifically approved for this purpose.
4. For analog cables provide individually shielded pairs or triads, as required for application, with overall shield and No. 16 or larger standard conductors.

D. Listing.

1. Single Conductor. UL 83.
2. Tray Cable. UL 1277.

2.3 SHIELDED VFD CABLES

A. Construction.

1. The cable shall be 600V/1000V rated, with stranded tinned copper conductors, shielded, suitable for use with Variable Frequency Drives.
2. The insulation shall be rated for 90 degrees Celsius Wet/Dry operating temperature.
3. Accessories (terminations) shall have ratings that are at least equal to those of the cable.
4. Cable shall be free from material and workmanship defects.
5. All cables shall be round.
6. Cable shall be suitable for use in wet/dry locations, indoors and outdoors, in cable trays, in conduits, trenches, and in underground ducts and direct burial.

B. Conductor. The conductor shall be annealed stranded tinned copper per ASTM B3, B8, and B33.

C. Insulation.

1. The insulation thickness shall have a minimum average wall thickness of 30 mils. The insulation material must be XLPE with a XHHW-2 listing per UL 44. Each insulated conductor shall be identified in accordance with ICEA Method 4 color coding.
2. The insulated conductors are to be cabled together with a minimum of one ground wire. The ground wire(s) are to have a minimum circular mil area equivalent to one circuit conductor. Fillers shall be included as necessary to make the cable round.

D. Shielding.

1. The cabled assembly shall be shielded using one of two methods:
2. Applying helically two 2-mil copper tapes. The shield shall provide 100% coverage over the assembly.
3. Applying a 80% minimum coverage tinned copper braid shield used in conjunction with an Aluminum Foil shield tape.

E. Jacket.

1. All cables shall have a continuous overall outer sheath of Polyvinyl Chloride (PVC), suitable for 90°C use.
2. The jacket shall be resistant to abrasion, rated for direct burial, sunlight resistant and flame resistant in accordance with UL 1277.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Protection. Unless otherwise indicated, mechanically protect conductors for systems by installing in raceways. Do not install the conductors until raceway system is complete and properly cleaned. Use Polywater J cable lubricant when pulling conductors. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of 600-volt insulated conductors. Do not exceed manufacturer's recommended values for maximum pulling tension.

B. Splices and Terminations. Use pressure-type lugs or connectors for terminations or splices of all stranded conductors. Use ring-tongue type terminators on all control wiring. Make grounding (earth) conductor approximately 2 inches longer than the ungrounded (phase) conductors at both ends. Refer to Section 16060.

C. Appearance. Neatly and securely bundle or cable all conductors in an enclosure using nylon straps with a locking hub or head on one end and a taper on the other.

3.2 600-VOLT INSULATED CONDUCTORS

A. Size. Install conductor sizes as indicated.

B. Home Runs. Except where specifically indicated, provide branch circuit home runs with not more than two different line conductors and a common neutral in a single raceway for 3-wire, single-phase systems, nor more than three different line conductors and a common neutral in a single raceway for 4-wire, 3-phase systems. Use home run circuit numbers as indicated for panelboard connections.

C. Color Code. Use factory-colored insulated conductors for No. 10 and smaller conductors and color code larger insulated conductors with an approved field-applied tape. Use different colors for control wiring. Follow the color scheme below.

Line	240/120	208/120	480/277
A or L1	Black	Black	Brown
B or L2	Red	Red	Orange
C or L3	Orange	Blue	Yellow
Neutral	White	White	Gray
Ground	Green	Green	Green
Switch Leg	Pink	Pink	Pink

Where more than one conductor of the same phase or more than one neutral conductor occur at the same outlet or junction box, these conductors shall be identifiable from each other by use of stripes or distinguishing markings.

D. Field Testing. Insulation resistance of all conductors shall be tested. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps and connections are made except connection to or into its source and point (or points) of termination. Insulation resistance of conductors which are to

operate at 600 volts or less shall be tested by using a Biddle Megger of not less than 1000 volts d-c. Insulation resistance of conductors rated at 600 volts shall be free of shorts and grounds and have a minimum resistance phase-to-phase and phase-to-ground of at least 10 megohms. Conductors that do not exceed insulation resistance values listed above shall be removed at Contractor's expense and replaced and test repeated. The Contractor shall furnish all instruments and personnel required for tests, shall tabulate readings observed, and shall forward copies of the test readings to the Owner in accordance with Section 16050. These test reports shall identify each conductor tested, date and time of test and weather conditions. Each test shall be signed by the party making the test.

END OF SECTION

SECTION 16130

RACEWAYS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of electrical raceway systems.

A. Conduit.
   1. Rigid aluminum conduit.
   2. PVC-coated rigid aluminum conduit.
   3. Rigid nonmetallic conduit.
   4. Liquid-tight flexible metal conduit.

B. Wireways.

C. Cable Tray.

1.2 REFERENCE STANDARDS

A. ANSI C80.3 - Electrical Metallic Tubing - Zinc-Coated.

B. ANSI C80.5 - Rigid Aluminum Conduit.

C. ANSI/UL 360 - Liquid-tight Flexible Steel Conduit.

D. ANSI/UL 467 - Electrical Grounding and Bonding Equipment.

E. ANSI/UL 651 - Schedule 40 and 80 Rigid PVC Conduit.

F. ANSI/UL 870 - Wireways, Auxiliary Gutters and Associated Fittings.

G. NEMA VE 1 - Metallic Cable Tray Systems.

1.3 SUBITTALS

Submit product data in accordance with Section 01300.

PART 2 - P R O D U C T S

2.1 CONDUIT AND FITTINGS

A. Rigid Aluminum Conduit.
   1. Conduit. Rigid copper-free aluminum (alloy 6063-T1) conduit (RAC).
   2. Fittings. Threaded aluminum.
   3. Acceptable manufacturers: Allied Tube & Conduit, American Conduit.

B. Rigid Nonmetallic Conduit.

1. Conduit. Schedule 40 polyvinyl chloride (PVC).
2. Fittings. Solvent weld socket type.
3. Bodies. Form 8.

C. PVC-Coated Rigid Metal Conduit.

1. Conduit. Same as rigid metal conduit plus a factory-applied, 40-mil-thick covering of polyvinyl chloride (PVC) bonded to the metal. ETL verified PVC-001.
2. Fittings. Same as rigid metal conduit fittings plus a factory-applied, 40-mil-thick covering of PVC bonded to the metal.
3. Bodies. Form 8.
4. Training. Schedule and provide "hands-on" training for installing personnel on proper preparation, installation and touch-up.

D. Liquid-tight Flexible Steel Conduit.

1. Conduit. Spiral-wound, square-locked, hot-dipped galvanized steel strip plus a bonded outer jacket of PVC.
2. Fittings. Compression type, malleable iron, with insulated throat, either cadmium plated or hot-dipped galvanized.

2.2 WIREWAYS

A. Material. Not less than 16-gauge thickness.

B. Dimensions. Cross section dimensions not less than 4 inches by 4 inches.

C. Type.

1. Unless noted in drawings provide the following:

a. Indoor non-corrosive areas. NEMA 1, painted steel.
b. Indoor corrosive and outdoor areas. NEMA 4X, 316 stainless steel.

2.3 CABLE TRAY AND FITTINGS

A. Material.

1. In dry wells and non-corrosive areas. Aluminum alloy 6063 with fasteners of aluminum alloy 2024.

2. In wet-wells and corrosive areas. Polyester reinforced fiberglass with fasteners of 316 stainless steel.

B. Dimensions. (Exceptions noted on drawings.)

1. Depth: four inches, minimum inside depth.
2. Width: as shown on the drawings.
3. Radius: as determined by cable bending requirements.

C. Type. Ladder, with six-inch rung spacing.

PART 3 - E X E C U T I O N

3.1 CONDUIT AND FITTINGS

A. Minimum Trade Size.

1. Above Grade. ¾ inch.
2. Below Grade. 1 inch.

B. Types According to Use. Use rigid aluminum conduit (RAC) throughout the project except as specified below.

1. Use PVC-coated RAC for above grade exterior conduit at the following areas:
   a. Headworks.
   b. Odor Control System.
   c. Clarifiers.
   d. Aeration Basins.
   e. RAS/WAS.
   f. NPW System.
   g. Filters/UV Disinfection.
2. PVC-coated RAC or rigid nonmetallic conduit 1 inch and smaller may be embedded in slabs if the slab thickness is a minimum of 5 inches thick. Conduit placement shall not impair the slab's structural integrity.
3. Use PVC-coated RAC or rigid nonmetallic conduit encased in concrete, in ductbanks, with minimum 3-inch-thick walls, for conductors installed below grade at a minimum depth of 24 inches to top of conduit. All horizontal to vertical transitions shall be made using PVC–coated RAC elbows and PVC-coated RAC conduit stub-ups.
4. Use direct-buried PVC conduit for conductors installed below foundations. All horizontal to vertical transitions shall be made using PVC–coated RAC elbows and PVC–coated RAC conduit stub-ups.
5. Do not allow RAC to make direct contact with concrete or earth.
6. Connect all electrical equipment subject to vibration or movement with liquid-tight flexible metal conduit 24 inches minimum length.
7. Chain-Hung Fixtures. Provide liquid–tight flexible metal conduit from a junction box directly above the fixture. Conduit length shall be such that the fixture weight is not borne by the conduit and does not cause excessive sag.
8. Transitions.
   a. Where rigid nonmetallic conduit is used in concrete encasement or under concrete slabs, a conversion to PVC–coated RAC shall be made at least 3 feet before the run exits the encasement or slab cover.
   b. For below-grade to above-grade locations, extend concrete encasement around conduit 4 inches above finished grade and slope top away from conduit with a 6-inch-per-foot slope. This provision does not apply for conduits extending into pad-mounted or floor-mounted equipment.

C. Preparation. Place sleeves in walls and floor slabs for the free passage of cables or conduits. Set sleeves in place a sufficient time ahead of concrete placement so as not to delay the work. Seal all openings and voids around sleeves through floors and walls. Be sure that plugs or caps are installed before concrete placement begins.

D. Installation Requirements.

1. Metallic conduits must be continuous between enclosures such as outlet, junction and pull boxes, panels, cabinets, motor control centers, etc. The conduit must enter and be secured to enclosures so that each system is electrically continuous throughout. Where knockouts are used, provide double locknuts, one on each side. For RAC, provide nonmetallic insulating bushings for conductor protection. Where conduits 1-1/2 inches and larger terminate in equipment having a ground bus, such as in switchgear, motor control

centers and panelboards, provide conduit with an insulated grounding bushing and a suitable grounding conductor terminated at the ground bus.

2. Have rigid nonmetallic conduit adequately solvent welded at joints to form a tight, waterproof connection.

3. Run concealed conduit as directly and with the largest radius bends as possible. Run exposed conduit parallel or at right angles to building or other construction lines in a neat and orderly manner. Conceal conduit in finished areas. Unless otherwise noted, remaining conduit may be exposed. Provide chrome-plated floor and ceiling plates around conduits exposed to view and passing through walls, floors, partitions, or ceilings in finished areas. Select properly sized plates to fit the conduit when securely locked in place.

E. Installation Methods.

1. Install each entire conduit system complete before pulling in any conductors. Clean the interior of every run of conduit before pulling in conductors to guard against obstructions and conduit omissions.

2. Cut all joints square, then thread and ream smooth.

3. Make bends with standard ells or conduit bent in accordance with the NEC. Make field bends using equipment designed for the particular conduit material and size involved. Bends must be free from dents or flattening. Use no more than the equivalent of four 90-degree bends in any run between terminals and cabinets, or between outlets and junction boxes or pull boxes.

4. Conduit bodies may be used in lieu of conduit ells where ease of installation and appearance warrants their use. Conduit bodies larger than 1 inch may be used only where approved.

5. Securely fasten and support conduit to structure or metal framing using hot-dipped galvanized, malleable iron pipe straps or other approved means. Wires of any type may not be used for securing conduits. Branch circuit raceways which are 1 inch or smaller may be attached to wall studs by use of manufactured clips.

6. Provide a No. 30 nylon pulling line in conduits in which wiring is not installed under this work. Identify both ends of the line by means of labels or tags reading "Pulling Line - Telephone," etc.

7. Suitably cap conduit during construction to avoid water, dirt and trash entrance.

8. Use expansion-deflection fittings on conduit crossing structural expansion joints and on exposed conduit runs where necessary. Provide bonding jumpers across fittings in metal raceway systems.

9. With a coupling, terminate concealed conduit for future use at structural surfaces. Install a pipe plug flush with the surface.

10. Openings around electrical penetrations of fire-resistance rated walls, partitions, floors or ceilings shall be firestopped to maintain the fire resistance rating using approved methods.

3.2 WIREWAYS

Install wireways, where shown, according to NEC Article 376.

3.3 CABLE TRAY

Install cable trays, where shown, according to NEC Article 392. Install cable trays in accordance with manufacturer's recommendations. Unless otherwise shown, support trays on 10-foot centers and as further recommended in NEMA Standard VE-1. Provide "Caution - Do Not Use as Walkway" signs suitably displayed at places to be designated by the Owner's representative.

END OF SECTION

SECTION 16135

BOXES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section specifies the furnishing and installation of outlet boxes, floor boxes, junction boxes, and pull boxes.

1.2 REFERENCE STANDARDS

A. ANSI/NEMA Publication No. OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers and Box Supports.

B. ANSI/UL 514A - Metallic Outlet Boxes.

C. ANSI/UL 514B - Fittings for Conduit and Outlet Boxes.

1.3 SUBMITTALS

Provide product data in accordance with Section 01300.

PART 2 - P R O D U C T S

2.1 OUTLET BOXES

A. Exposed Device Boxes. Provide PVC-coated FS or FD cast aluminum boxes for surface mounting in corrosive areas. Provide cast aluminum boxes for surface mounting in areas having exposed RAC.

B. Masonry Boxes. Provide galvanized steel, 3-1/2-inch deep, masonry boxes for all devices installed in masonry walls.

C. Switch Boxes. Not permitted.

D. Listing. UL 514.

2.2 JUNCTION, PULL AND SPLICE BOXES

A. Construction. Provide 316 stainless steel boxes conforming to NEC Article 314.

B. Interior Spaces. Provide NEMA 1 type boxes at least 4 inches deep.

C. Exterior Spaces. Provide NEMA 4X type boxes at least 4 inches deep.

D. Embedded. Provide NEMA 4 cast iron type with flush flanged cover when cast in concrete.

E. Listing. UL 514.

PART 3 - E X E C U T I O N

3.1 OUTLET BOXES

A. Fixture Boxes. Where boxes for suspended lighting fixtures are attached to and supported from suspended ceilings, adequately distribute the load over the ceiling support members.

B. Mounting Height. Mounting height of a wall-mounted outlet box means the height from finished floor to horizontal center line of the cover plate. Where outlets are indicated adjacent to each other, mount these outlets in a symmetrical pattern with all tops at the same elevation. Where outlets are indicated adjacent, but with different mounting heights, line up outlets to form a symmetrical vertical pattern on the wall. Verify the final location of each outlet with Owner's representative before rough-in. Remove and relocate any outlet box placed in an unsuitable location.

C. Back-to-Back Boxes. Do not connect outlet boxes back to back unless approval is obtained from the Owner's representative. Where such a connection is necessary to complete a particular installation, fill the voids around the wire between the boxes with sound insulating material.

D. Box Openings. Provide only the conduit openings necessary to accommodate the conduits at the individual location.

3.2 JUNCTION AND PULL BOXES

A. Installation. Install boxes as required to facilitate cable installation in raceway systems. Generally provide boxes in conduit runs of more than 100 feet.

B. Covers. Provide boxes so that covers are readily accessible and easily removable after completion of the installation. Include suitable access doors for boxes above inaccessible ceilings. Select a practical size for each box and cover.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section specifies the furnishing and installation of wiring devices and device plates.

1.2 REFERENCE STANDARDS

A. Americans with Disabilities Act (ADA).

B. ANSI/UL 20 - General-Use Snap Switches.

C. ANSI/UL 498 - Attachment Plugs and Receptacles.

D. ANSI/UL 943 - Ground Fault Circuit Interrupters.

E. NEMA WD 1 - General Requirements for Wiring Devices.

1.3 SUBMITTALS

Provide product data on wiring devices and plates in accordance with Section 01300.

PART 2 - P R O D U C T S

2.1 WALL SWITCHES

A. Type. Quiet type, back and side wired switches as shown.

B. Rating. 20 amperes, 120/277 volts.

C. Listing. UL 20 and Federal Specification W-S-896.

D. Acceptable Manufacturers. The following designations are for brown devices; provide devices in the color specified in Article 2.4.

Type	Arrow Hart	Bryant	GE	Hubbell
S	1991	4901	5951	HBL1221
S_2	1992	4902	5952	HBL1222
S_3	1993	4903	5953	HBL1223
S_4	1994	4904	5954	HBL1224
S_K(1)	L	L	OLG	L
S_P(2)	PL	PLR120	SP121-8G	PL

(1) Key operated switch: add the indicated suffix to the above designations.
(2) Switch with red pilot light: add the indicated suffix to the above designations. (Not available in S_4.)

2.2 RECEPTACLES

A. Type. Back and side wired receptacles.

B. Rating. Scheduled on drawings.

C. Listing. UL 498 and Federal Specification W-C-596.

D. Acceptable Manufacturers. The following designations are for brown devices; provide devices in the color specified in Article 2.4.

NEMA Config.	Arrow Hart	Bryant	GE	Hubbell
5-15R	5262	5262	5262-1	5262
6-15R	5662	5662	5662-1	5662
5-20R	5362	5362	5362-1	5362
6-20R	5462	5462	5462-1	5462
14-20R	5759	C	1420	8410
15-20R	5781	C	1520	8420
5-30R	5716N	9530-FR	4138-3	9308
6-30R	5700N	9630-FR	4139-3	9330
14-30R	5744N	9430-FR	4191-3	9430A
15-30R	8430N	8430-FR	1530-3	8430A
GFCI	GF8300	GFR83FT	GFR8300	GF-8300

2.3 DEVICE PLATES

A. Finished Spaces. Use 302 stainless steel (18 percent chromium, 8 percent nickel) (9300 series of the device manufacturers listed above.

B. Exposed Boxes in Dry Interior Spaces. Make plates of heavy cadmium-plated sheet steel. Edges of plates must be flush with edges of boxes.

C. Hose-down and Exterior Areas. Use weatherproof device plates. Provide enclosure with gasketed cover for protection of device and meeting the requirements of NEC-410-57b.

D. Acceptable Manufacturer. TayMac No. 71204 or approved substitution.

2.4 DEVICE COLOR

Use wiring devices in ivory for non-finished and light finished walls. Use wiring devices in brown for dark finished walls.

PART 3 - E X E C U T I O N

3.1 DEVICE COORDINATION

Where items of equipment are provided under other sections of this specification or by the Owner, provide a compatible receptacle for the cap or plug and cord of the equipment.

3.2 WALL SWITCHES

A. Location. Set wall switches in a suitable outlet box centered at the height of 44 inches from the floor, except as otherwise shown on the drawings. Install switch on the strike side of the door as finally hung.

B. Position. Install wall switches in a uniform position so the same direction of operation will open and close the circuits throughout the job, generally up for the ON position.

3.3 RECEPTACLES

Mount receptacles vertically with the ground on top in a suitable steel outlet box centered at the height of 18 inches from the floor, except as otherwise shown on the drawings. For horizontally mounted receptacles, ground should be on left. Reasonable changes in receptacle locations may be directed without change in the contract sum.

3.4 DEVICE PLATES

A. Type. Provide device plates for each outlet of the type required for service and device involved.

B. Ganged Devices. Mount ganged devices under a single, one-piece, device plate.

C. Engraving. Engrave plates with 1/8-inch-high black letters, if designated for engraving.

3.5 WIRING DEVICES

Install wiring devices in accordance with applicable requirements of the NEC, NEMA, ANSI, and the product manufacturer recommendations. Provide pig-tail connection to devices with down-stream devices. Do not feed through devices to connect to down-stream devices.

END OF SECTION

SECTION 16145

TIME SWITCHES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of electronic-type individually enclosed time switches.

1.2 REFERENCE STANDARDS

A. UL 916 - Energy Management Equipment.

B. UL 917 - Clock-Operated Switches.

1.3 SUBMITTALS

Submit product data in accordance with Section 01300.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

Tork, Grasslin, Intermatic, Paragon, Zenith.

2.2 TYPE

Provide 7-day calendar electronic-type time switches powered by a 120-volt, 60-hertz power supply. Use units capable of being programmed for up to six different operations each day of the week, with an operating trip accuracy equivalent to line frequency and a minimum of one minute between an on and off operation.

2.3 CONTACTS

Provide double-pole, double-throw contacts rated 277 volts, 30 amperes per pole inductive.

2.4 ENCLOSURE

Supply each time switch in a lockable NEMA 4X enclosure suitable for surface mounting.

2.5 LOR SWITCH

Include a cover-mounted Local-Off–Remote (LOR) selector switch for each circuit. Wire LOR switch to permit selecting the mode of operation of the controlled equipment without changing the programmed operation of the time switch. Provide separate pole for each ungrounded conductor in each circuit.

2.6 RESERVE POWER

Use units with field replaceable batteries with a minimum 24-hour backup capability and minimum 3-year replacement interval. Provide a battery recharge feature which operates on power restoration.

2.7 PHOTOCELL

Provide unit suitable for connection of a photocell input to operate contacts in response to ambient light levels. Timer unit shall be capable of overriding photocell input, to allow control by both photocell and timer.

2.8 LISTING

UL 916 (electronic timers).

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install time switches in locations as shown and as recommended by the manufacturer. Synchronize all time switches and set on and off trippers as directed by the Owner.

B. Install photocell on building roof facing north.

END OF SECTION

SECTION 16170

METAL FRAMING

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision and installation of metal framing, including channels, fittings, clamps, hardware, electrical accessories, and brackets.

1.2 REFERENCE STANDARDS

NEMA ML 1 – Metal Framing.

1.3 SUBMITTALS

Submit product data in accordance with Section 01300.

PART 2 - P R O D U C T S

2.1 CHANNELS, FITTINGS, CLAMPS, ELECTRICAL ACCESSORIES, AND BRACKETS

A. Corrosive Areas. 316 stainless steel with 316 stainless steel or PVC-coated steel hardware. Galvanized hardware is not acceptable.

B. Non-corrosive areas. Aluminum with aluminum hardware.

C. Fabricate threaded fasteners of Type 316 stainless steel.

2.2 SIZES

Provide channels fabricated from not less than 12-gauge thickness, 1-5/8 inches wide, and not less than 1-5/8 inches deep.

2.3 ACCEPTABLE MANUFACTURERS

B-Line Systems, Inc.; Elcen Metal Products Company; Electrical Products Division, Midland-Ross Corporation; Metal Products Division, U.S. Gypsum Company; Power Strut; Unistrut.

PART 3 - E X E C U T I O N

3.1 SUPPORTS

Provide metal framing to support wall-mounted equipment, wall-mounted raceways, and ceiling-hung raceways.

3.2 ANCHOR BOLTS

A. Use 1/2-inch diameter by 3 inches long Type 316 stainless steel expansion bolts to attach framing to concrete.

B. Space bolts a maximum of 24 inches on center, with not less than two bolts per piece of framing.

END OF SECTION

SECTION 16191

MISCELLANEOUS EQUIPMENT

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision and installation of all miscellaneous equipment as shown on the Drawings and as specified herein.

1.2 REFERENCE STANDARDS

Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in Division 16.

1.3 SUBMITTALS

Submit product data in accordance with Section 01300.

PART 2 - P R O D U C T S

2.1 MATERIALS

A. Manual Motor Starters.

1. Manual starters shall be suitable for the voltage and number of phase shown on the Drawings and shall be non-reversing, reversing or two speed type as shown on the Drawings. NEMA sizes shall be as required for the horsepowers shown on the Drawings. Manual starters shall have motor overload protection in each phase.
2. NEMA 4 enclosures shall be stainless steel.
3. NEMA 4X enclosures shall be stainless steel.
4. NEMA 7 enclosures shall be copper free cast aluminum.
5. Manual motor starters shall be as manufactured by General Electric, Schneider Electric, or approved substitution.

B. Corrosion Inhibitors.

1. All equipment enclosures, terminal boxes, etc, located in a NEMA 4X rated area (where shown on the Drawings) that contains electrical or electronic equipment or terminal strips shall be furnished with an internally-mounted, chemically-treated corrosion inhibitor pad.

2. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co., 3M or equal.

C. Equipment Mounting Stands.

1. Equipment mounting stands shall be custom fabricated from 1/4-in steel plate and 4-in steel channel.
2. Hot dip galvanizing shall conform to the requirements of Division 5.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Mounting Stands. Field-mounted disconnects, pushbutton control stations, etc, shall be mounted on steel stands. Where clearance requirements for stands may not be maintained, the ENGINEER may direct equipment to be wall-mounted adjacent to the drive, but in no case shall the distance from the drive motor to the control station exceed 3-ft.

END OF SECTION

SECTION 16210

ELECTRICAL SERVICE

PART 1 - G E N E R A L

1.1 SUMMARY

Arrange for permanent electrical services to serve to new WWTP. Temporary (construction phase) power is specified in Section 01500.

1.2 REFERENCE STANDARDS

Comply with all service installation standards of CenterPoint Energy.

1.3 SOURCE

Electrical service will be provided from utility's system. The source characteristics are 480 volts, 3 phase, 4 wire, 60 hertz. Service to the project will be run via underground service off Lafiets Point Rd. for WWTP Services. Refer to plans for proposed utility transformer pad location and primary service conduits. Coordinate with the utility for final termination of the proposed primary service conduits. Existing utility services that feed existing lift station and existing WWTP to remain in service.

1.4 COORDINATION

The location of the service entrance must be coordinated with the Area Engineer Listed below. Provide materials and equipment required to connect the project service to the utility system.

Curtis Newberry

Curtis.Newberry@centerpointenergy.com

409.465.4022

PART 2 - P R O D U C T S

Not used.

PART 3 - E X E C U T I O N

3.1 PREPARATION

A. Application for Service. Verify that an application for service has been submitted to the utility. If application for service is not filed with utility, prepare application and coordinate with Owner to submit application for service.

B. Service Outlet Location and Data Statement. Secure a service outlet location and data statement ("statement") from the utility company. Verify that the information on the statement is correct, including type of

service, service facility arrangement, and location of service outlet. Notify Owner and Engineer immediately of any and all discrepancies between contract documents and statement and propose a resolution.

3.2 INSTALLATION

Install the utility services as required by the contract documents. Demonstrate that the electrical system is operational.

3.3 OUTAGES

Schedule power outages to avoid interference with the Owner's activities. Obtain approval from Owner at least 30 days prior to the requested outage. If required by the Owner, provide a schedule showing sequence and duration of all activities during the requested outage.

END OF SECTION

SECTION 16222

AC ELECTRIC MOTORS – 100HP AND BELOW

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Equipment. This section specifies general requirements for 1-phase and 3-phase electric motors with NEMA frame machines sized through 100 horsepower. Unless otherwise specified, provide motors meeting the basic requirements for general-purpose alternating current motors, as defined in ANSI/NEMA MG 1-1.05.

B. Unit Responsibility. Motors are furnished under other sections of this specification as a part of the driven equipment. The Contractor is responsible for all coordination between the various components and for the warranty.

C. Statement. The Contractor shall be responsible for obtaining information on the existing pump/motor from the pump manufacturer. Contractor shall coordinate the motor being furnished with the existing pump manufacturer for torque characteristics and bearing size for the pumping application. Contractor shall furnish a written statement that the motor being furnished has been coordinated with the pump manufacturer.

D. Exceptions. Exceptions to this section are indicated either in the various sections that specify motor-driven equipment or on the drawings.

1.2 REFERENCE STANDARDS

A. ANSI/IEEE 117 - Standard Test Procedure for Evaluation of Systems of Insulating Materials for Random Wound AC Electric Machinery.

B. ANSI/NEMA MG 1 - Motors and Generators.

C. ANSI/NEMA MG 2 - Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors.

D. ANSI/UL 674 - Electric Motors and Generators for Use in Hazardous (Classified) Locations.

E. ANSI/UL 1004 - Electric Motors.

1.3 SUBMITTALS

A. Provide the following information in accordance with Section 01300:

1. Manufacturer.
2. Rated full load horsepower.
3. Rated volts.
4. Number of phases.
5. Frequency in hertz.
6. Full load amperes (FLA).
7. Locked rotor amperes (LRA) at rated voltage or NEMA code letter.
8. Nominal speed at full load (rpm).
9. Service factor.
10. NEMA design letter.
11. NEMA machine type (ODP, WP-I, TEFC, etc.).

B. For motors 1 horsepower and larger, include the following additional information:

1. NEMA frame size.
2. NEMA insulation system classification. For motors required to be installed outdoors, include information showing compliance with the intent of paragraph 2.3C.
3. Maximum ambient temperature for which motor is designed.
4. Time rating.
5. Bearing type.
6. Efficiency at full load.

C. For motors 20 horsepower and larger, include the following additional information:

1. No load amperes.
2. Safe stall time.
3. Efficiency at 1/2 and 3/4 load.
4. Power factor at no load, 1/2, 3/4 and full load.
5. Motor manufacturer's recommended maximum power factor correction capacitor (kvar) that can safely be switched with the motor.
6. Expected value of corrected power factor at no load, 1/2, 3/4 and full load.
7. Full load amperes with corrected power factor.
8. Maximum guaranteed slip at full load.

D. For motors with space heaters, include space heater voltage and wattage.

PART 2 - P R O D U C T S

2.1 RATING

A. Speed and Size. Speed and approximate horsepower ratings are specified in the driven equipment specification sections or are indicated on the drawings. Furnish motors sufficiently sized for the particular application and with full-load rating not less than required by the driven equipment at specified capacity. Size motors so as not to overload at any point throughout the normal operating range.

B. Voltage.

1. Single phase: 115 volts for 120-volt nominal system voltage.
2. Three phase: 200 volts for 208-volt nominal system voltage.
3. Three phase: 230 volts for 240-volt nominal system voltage.
4. Three phase: 230/460 volts for 240/480-volt nominal system voltage.
5. Three phase: 460 volts for 480-volt nominal system voltage.

C. Frequency. 60 hertz.

D. Service Factor. According to NEMA MG 1-12.47 but not less than 1.15.

E. Acceleration Time. For integral horsepower motors, if the calculated acceleration time of the combined motor and driven load exceeds 3 seconds at 90 percent of rated voltage, request review by the Owner's representative. Do not proceed with manufacturing without approval.

F. Safe Stall Time. For integral horsepower motors, if the safe stall time is less than 15 seconds when hot, request review by the Owner's representative. Do not proceed with manufacturing without specific approval.

G. Efficiency. Provide energy-efficient motors meeting the requirements of NEMA MG 1-12.55A, Table 12Y and MG 1.41.3. Efficiency to be determined by testing in accordance with NEMA MG 112.53 using IEEE 112A - Method B.

2.2 DESIGN TYPE

A. Motors Smaller than 1/6 Horsepower. Provide single-phase squirrel-cage induction motors with integral thermal protectors.

B. Motors 1/6 through 1/2 Horsepower. Provide single-phase NEMA Design Letter N, squirrel-cage induction motors.

C. Motors Larger than 1 Horsepower. Provide 3-phase, NEMA Design Letter B, squirrel-cage induction motors.

D. Motors Used with Solid State Variable Frequency Drives. Provide 3-phase, NEMA Design Letter B, squirrel-cage induction motors, inverter rated. Motor manufacturer shall provide a written statement that the motor is compatible with VFDs.

2.3 MOTOR INSULATION

A. Class. Use a Class F insulation with Class B Temperature rise system meeting the requirements of NEMA MG 1-1.65 and made of nonhygroscopic materials.

B. Outdoor Suitability. Where motors must be suitable for outdoor installation, the insulation must withstand 1 full week (168 hours) of testing in a chamber maintained at 100 percent relative humidity and 40 C ambient temperature. Immediately after the test period, the insulation system must have a minimum resistance of 1.5 megohms. In addition, the inside circumference of the stator and the outside circumference of the rotor and shaft must be coated with the same moisture-resistant insulation.

2.4 LEADS

For motor leads, use not less than ASTM B 173, Class G, stranded copper conductors with insulation the same as or better than specified in the preceding Motor Insulation paragraph. Provide permanent identification numbers on leads according to NEMA MG 1-2.02. Use crimp-on, solderless copper terminals on leads and place heat-shrink insulation sleeves or covers between leads and terminals.

2.5 ENCLOSURE

A. Indoors. Totally enclosed, fan cooled (TEFC). Use steel frame for motors smaller than 3/4 horsepower, and cast-iron frame for motors 3/4 horsepower and larger.

B. Outdoors.

1. Horizontal Motors: TEFC with a corrosion-resistant drain plug under each bearing.
2. Vertical Motors. Weather-protected Type I (WP-1).

C. Hazardous Areas. Provide cast-iron frame motors suitable for use in the classified area.

2.6 BEARINGS

A. Motors Smaller than 1/6 Horsepower. Motor manufacturer's standard bearing is acceptable.

B. Motors 1/6 Horsepower and Larger.

1. Antifriction. Supply motors with grease-lubricated antifriction ball bearings conservatively rated for long life under the total radial and thrust loads produced by the actual combination of motor-driven equipment. Provide each motor with suitable lubrication fittings and pressure relief devices suitable for in-service lubrication.
2. Oil Lubricated. If the driven equipment section specifies oil-lubricated bearings for motors, include a suitable sight gauge on each bearing with maximum and minimum levels clearly indicated.

2.7 HARDWARE

Use structural bolts, washers, nuts, pins, and similar items manufactured of high-strength steel. Use only hexagon-head bolts and hexagon nuts. Use corrosion-resistant materials or protect hardware from corrosion by either hot-dip galvanizing, chrome plating or cadmium plating.

2.8 NAMEPLATES

A. Main Nameplate. Provide each motor with a stainless steel nameplate meeting the requirements of NEMA MG 1-10.38, and the National Electrical Code, Section 430-7. Energy-efficient motors shall be identified in accordance with MG-1-12.54.2.

B. Heater Nameplate. When space heaters are furnished, include voltage and wattage on a suitable nameplate.

C. Bearings Nameplate. When bearings are oil lubricated, include oil type information on a suitable nameplate. Also, indicate bearing data if nonstandard.

D. Attachment. Attach the nameplates to the motor with stainless steel fastening pins or screws.

2.9 CONDUIT BOX

For each motor not supplied with a cord and plug, provide a conduit box suitably sized for the motor lead terminations, in accordance with the National Electrical Code, Section 430-12. Include a grounding lug for motors 1/6 horsepower and larger. Supply a gasket suitable for the motor enclosure type and application.

2.10 SPACE HEATERS

Provide space heaters on motors located outdoors or when specified in the driven equipment section. Use heaters hermetically sealed in stainless steel or equivalent corrosion-resistant sheaths. Rate heaters 115 volts, 60 hertz. Braze heat-resistant insulated leads to the heater and extend to the conduit box. Size heaters according to the motor frame size as follows:

Frame Number Series	Minimum Watts	Corresponding HP at 1800 SRPM
Less than 280	Not required	
280 - 320	100	20 - 50
360 - 400	150	60 - 125
440	200	
150 - 200		

2.11 TEMPERATURE SENSORS

For motors sizes 20 hp and larger, unless noted otherwise, shall be equipped with motor winding temperature sensors, one per winding (3 total), and one per bearing (up to 2 total). The sensor contacts shall be normally closed which open when high temperature is detected.

2.12 PAINT

Manufacturer's standard shop paints for prime and finish coats are acceptable.

2.13 NOISE

Provide integral horsepower motors with overall sound power levels meeting the requirements of MG 1-12.49.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

Properly install and align motors in the locations shown, except motors which are factory mounted on the driven equipment. Use crimp-on, solderless copper terminals on the branch circuit conductors. For motors 20 horsepower and larger, use 5300 series 3M motor lead splicing kit or approved equal. When the motor and equipment are installed, the nameplate must be in full view.

3.2 LARGER MOTORS

If a motor horsepower rating larger than indicated is offered as a substitute and accepted, provide required changes in size of conductors, conduits, motor controllers, overload relays, fuses, circuit breakers, switches and other related items at no change in the contract price.

3.3 FIELD TESTING

A. General. Provide all necessary instruments, labor and personnel required to perform motor inspection and testing.

B. Inspection. Inspect all motors for damage, moisture absorption, alignment, freedom of rotation, proper lubrication, oil leaks, phase identification and cleanliness, and report any abnormalities to Owner's representative before energizing.

C. Tests. All motors 20 horsepower and larger shall be megger tested, in accordance with IEEE Report No. 43, "Recommended Practices for Testing Insulation Resistance of Rotating Machinery," to determine insulation resistance. In addition, motor full load current and full load voltage shall be measured. Motor Test Report forms included at the end of this section shall be completed and submitted to the Owner's representative.

D. Energizing. After installation has been thoroughly checked and found to be in proper condition, with thermal overloads in motor controllers properly sized and all controls in place, energize the equipment at system voltage for operational testing.

END OF SECTION

DATE _____

SHEET _____ OF _____

MOTOR TEST REPORT

PROJECT NAME _____

PROJECT NO. _____

MOTOR MANUFACTURER _____

MOTOR DESIGNATION _____, LOCATION _____

HP _____, FLA _____, LRA _____, NOMINAL VOLTAGE _____

INSULATION CLASS _____

SERVED FROM PANEL/MCC _____

MEASURED CONDITIONS

TEMPERATURE: _____°F

RELATIVE HUMIDITY: _____%

CURRENT (AMPS): ∅A _____, ∅B _____, ∅C _____

VOLTAGE (VOLTS): ∅AB _____, ∅BC _____, ∅CA _____

∅AN _____, ∅BN _____, ∅CN _____

INSULATION RESISTANCE:

∅AB _____, ∅BC _____, ∅CA _____

∅A-GND _____, ∅B-GND _____, ∅C-GND _____

STARTING TIME: _____ SECONDS, SAT _____ UNSAT _____

VIBRATION: SAT _____ UNSAT _____

BEARING TEMPERATURE: SAT _____ UNSAT _____

SECTION 16230

DIESEL-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Diesel engine.
2. Diesel fuel-oil system.
3. Control and monitoring.
4. Generator overcurrent and fault protection.
5. Generator, exciter, and voltage regulator.
6. Outdoor engine generator enclosure.
7. Vibration isolation devices.

B. Related Requirements:

1. Section 16414 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.3 DEFINITIONS

A. EPS: Emergency power supply.

B. EPSS: Emergency power supply system.

C. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.

6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01730 "Operation and Maintenance Data," include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Replaceable Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 1 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar, Inc.; Electric Power Division.
2. Cummins Power Generation.
3. Generac Power Systems, Inc.
4. Kohler Power Systems.
5. MTU America Inc.

B. Source Limitations: Obtain packaged engine generators, transfer switches, and auxiliary components from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

1. Component Importance Factor: 1.0.

B. B11 Compliance: Comply with B11.19.

C. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 110 requirements for Level 2 EPSS.

D. UL Compliance: Comply with UL 2200.

E. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.

F. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at 78dB at nearest property line or at 23’ whichever is closer. due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

G. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 122 deg F. Delete "Relative Humidity" Subparagraph below for outdoor units.
2. Relative Humidity: Zero to 95 percent.
3. Altitude: Sea level to 500 feet.

H. Unusual Service Conditions: Engine generator equipment and installation are required to operate under the following conditions:

1. High salt-dust content in the air due to sea-spray evaporation.
2. High wind loads due to hurricanes:
   a. Wind Loads on Other Structures and Building Appurtenances; applied in accordance with Chapter 29 of the ASCE/SEI 7-05 Standard, “Minimum Design Loads for Buildings and Other Structures.”
      1) Basic Wind Speed, V = 150 mph (3-second gust; ultimate)
      2) Wind Directionality Factor, Kd = 1.0
      3) Exposure Category = C
      4) Importance Factor, I = 1.15

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, liquid-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Power Rating: Standby.

D. EPSS Class: Engine generator shall be classified as a Class 24 according to NFPA 110.

E. Service Load: Refer to drawings.

F. Power Factor: 0.8, lagging.

G. Frequency: 60 Hz.

H. Voltage: 480-V ac.

I. Phase: Three-phase, four wire, wye.

J. Induction Method: Turbocharged.

K. Governor: Adjustable isochronous, with speed sensing.

L. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

M. Engine Generator Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
b. All manufacturers will be required to submit a sizing report validating that the equipment presented can support the defined loads within these tolerances at the specified ambient conditions

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

    a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time:

    a. Comply with NFPA 110, Type 10 system requirements.

    b. 10 seconds.

2.4 DIESEL ENGINE

A. Fuel: ASTM D975, diesel fuel oil, Grade 2-D S15.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine or skid-mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499. The jacket coolant heater shall be thermostatically controlled, with isolating valves, and shall

maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1. A quantity of one block heater per generator set shall be supplied.

E. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Radiator core shall be modular and consist of multiple sections for ease of replacement in the event of damage
3. Temperature Tolerances of Radiator: Provide a [50] °C rated radiator.
4. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
6. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
    a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Muffler/Silencer:

1. Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
    a. Minimum sound attenuation of 25 dB at 500 Hz.
    b. Sound level measured at a distance of 23 feet from exhaust discharge after installation is complete shall be 78 dBA or less.
    c. Stainless steel or other anti-corrosive material not susceptible to hydrogen sulfide or salty air environment.

G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

H. Starting System: 24-VDC electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Nickel cadmium, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least twice without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. [.

7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

9. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for nickel-cadmium batteries. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 37.

B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 231113 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.

C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

D. Fuel Filtering: Remove water and contaminants larger than 1 micron.

E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Spill Containment: Provide fluid reservoir which will contain fluid and limit risk of overflow during fuel transfer.

G. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:

1. Tank level indicator.
2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for planned operation plus fuel for periodic maintenance operations between fuel refills plus fuel for the hours of continuous operation required for the indicated EPSS Class. (24 hours)
3. Leak detection in interstitial space.
4. Vandal-resistant fill cap.
5. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Provide minimum cool down run timer set for 15 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A and/or UL6200.

D. Configuration:

1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.

E. Control and Monitoring Panel:

1. Digital engine generator controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Instruments: Located on the control and monitoring panel and viewable during operation.

    a. Engine lubricating-oil pressure gage.
    b. Engine-coolant temperature gage.
    c. DC voltmeter (alternator battery charging).
    d. Running-time meter.
    e. AC voltmeter, connected to a phase selector switch.
    f. AC ammeter, connected to a phase selector switch.
    g. AC frequency meter.
    h. Generator-voltage adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:

    a. Cranking control equipment.
    b. Run-Off-Auto switch.
    c. Control switch not in automatic position alarm.
    d. Overcrank alarm.
    e. Overcrank shutdown device.
    f. Low-water temperature alarm.
    g. High engine temperature.
    h. High engine temperature shutdown device.
    i. Overspeed alarm.
    j. Overspeed shutdown device.
    k. Low fuel main tank.

        1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for duration required in "Fuel Tank Capacity" Subparagraph in "Diesel Fuel-Oil System" Article.

l. Coolant low-level alarm.
m. Coolant low-level shutdown device.
n. EPS load indicator.
o. Battery high-voltage alarm.
p. Low cranking voltage alarm.
q. Battery-charger malfunction alarm.
r. Battery low-voltage alarm.
s. Lamp test.
t. Contacts for local and remote common alarm.
u. Low-starting air pressure alarm.
v. Low-starting hydraulic pressure alarm.
w. Remote manual stop shutdown device.
x. Air shutdown damper alarm when used.
y. Air shutdown damper shutdown device when used.
z. Generator overcurrent-protective-device not-closed alarm.
aa. Hours of operation.
bb. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.

F. Communications:

1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.

G. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

1. Overcrank alarm.
2. Low water-temperature alarm.
3. High engine temperature prealarm.
4. High engine temperature alarm.
5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low fuel main tank alarm.
8. Low coolant level alarm.
9. Low cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Air shutdown damper when used.
13. Run-Off-Auto switch.
14. Control switch not in automatic position alarm.
15. Low-cranking voltage alarm.

H. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

I. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.

1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Overcurrent Protective Device:

1. Molded-case circuit breaker, thermal-magnetic type; 100 percent rated; complying with UL 489:

a. Tripping Characteristic: Designed specifically for generator protection.
b. Trip Rating: Matched to generator output rating.
c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
d. Mounting: Adjacent to, or integrated with, control and monitoring panel.

C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other engine generator protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other engine generator malfunction alarms.
2. Under single- or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

D. Required for Generators rated 1000A or more at 277/480Volt:

1. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.

a. Indicate ground fault with other engine generator alarm indications.
b. Trip generator protective device on ground fault.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six or 12-lead alternator.

E. Range: Provide standard range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Driproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.

2. Maintain voltage within 20 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 10 percent and stabilize at rated frequency within 5 seconds.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

M. automatic exercising.

2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

A. Description:

1. Vandal-resistant, sound-attenuating, weatherproof corrosive -resistant painted aluminum housing; and hurricane rated. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

a. Sound Attenuation Level at 100% load: 78db at 7 meters (23 feet).

2. Prefabricated or pre-engineered, galvanized-steel-clad, integral structural-steel-framed, or aluminum 3.2 mm (0.125 in.) formed panel, solid construction. Erected on concrete foundation.

B. The acoustic insulation used shall meet UL 94 HF1 flammability classification.

C. The enclosure must surpass a 3,000 hour salt spray corrosion test per ASTM B-1117.

D. Enclosures will be finished in the manufacturer's standard color.

E. The enclosures shall allow the generator set to operate at full load in an ambient temperature of 45°C with no additional derating of the electrical output of the generator set. The enclosure will account for no more than a 5°C derating of the electrical output of the generator set.

F. Enclosures shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker shall meet the requirements of the National Electric Code.

G. Doors shall be fitted with hinges, hardware, and the doors shall be removable.

H. Doors shall be equipped with lockable latches. Locks shall be keyed alike. Door locks shall be recessed to minimize potential of damage to door/enclosure.

I. A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air

J. Hurricane Rated Enclosure: Vandal-resistant, sound-attenuating, weatherproof aluminum housing; and include impact testing per FL Building Code requirements TAS 201, TAS 202, and TAS 203 standards. Impact testing shall meet Large Missile Level E requirements. Ultimate Design Pressure – Wall Panels ±65PSF. Ultimate Design Pressure – Roof Panels ±100PSF. The enclosure shall have an integral rodent guard and skid end caps and shall have bracing to meet 181 mph wind loading.

K. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads indicated.

L. Hinged Doors: With padlocking provisions.

M. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

N. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.

O. Electrical Panel –The generator set enclosure shall be furnished with a load center 120/208 VAC single phase, 100 amp max w/ main and 12 branch circuits. Panel shall be powered integral to the generator set.
   1. Interior Lights with Switch: Factory-wired, vapor-proof luminaires within housing; arranged to illuminate controls and accessible interior.
   2. (2) Convenience Outlets: Factory-wired, GFCI.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

   1. Material: Standard neoprene separated by steel shims.

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.

9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 404.

B. Comply with packaged engine generator manufacturers' written installation and alignment instructions.

C. Equipment Mounting:

1. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

2. Install packaged engine generator. Secure generator assembly to anchor bolts installed in concrete bases.

D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

E. Exhaust System: Install Schedule 40 black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet at a minimum and sized to backpressure to engine to an acceptable level as determined by the engine manufacturer.

3.3 IDENTIFICATION

A. Identify system components according to Section 16052 "Identifications."

B. Install a sign indicating the generator is installed as a separately derived system.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection:

        1) Compare equipment nameplate data with Drawings and the Specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify that the unit is clean.

    b. Electrical and Mechanical Tests:

        1) Perform insulation-resistance tests according to IEEE 43.

            a) Machines Larger Than 200 hp: Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 hp or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.

        2) Test protective relay devices.
        3) Verify phase rotation, phasing, and synchronized operation as required by the application.
        4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.

        5) Perform vibration test for each main bearing cap.
        6) Verify correct functioning of the governor and regulator.

2. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.

b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
c. Verify acceptance of charge for each element of the battery after discharge.
d. Verify that measurements are within manufacturer's specifications.

3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.

5. Exhaust Emissions Test: Comply with applicable government test criteria.
6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
7. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.

8. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 23 feet from edge of the generator enclosure, and compare measured levels with required values.

B. Coordinate tests with tests for transfer switches and run them concurrently.

C. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

D. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Remove and replace malfunctioning units and reinspect as specified above.

H. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.

I. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 16230

SECTION 16276

DRY-TYPE TRANSFORMERS - 600 VOLT PRIMARY AND BELOW

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of dry-type transformers with 600 volt and below primary and rated 500 kVA and smaller.

1.2 REFERENCE STANDARDS

Design, test, assemble and install in conformance to the latest edition of the following applicable industry standards.

A. ANSI/UL 506 - Specialty Transformers.

B. ANSI/UL 1561 - Dry-Type General Purpose and Power Transformers.

C. IEEE C57.94 - Recommended Practice for Installation, Application, Operation and Maintenance of Dry-Type General-Purpose Distribution and Power Transformers.

D. ANSI/NEMA ST 20 - Dry-Type Transformers for General Applications.

E. NFPA 70 - National Electrical Code (NEC).

1.3 SUBMITTALS

A. Submit the following information for each size and type of transformer being provided in accordance with Section 01300.

1. Manufacturer.

2. Rated kVA, number of phases and frequency.

3. Primary voltage and connections.

4. Secondary voltage and connections.

5. Number and percent taps.

6. Outline dimensions.

7. Total weight of unit.

B. Submit the following information for record purposes at closeout in accordance with Section 01730.

1. O&M Manual. The manufacturer shall furnish with the submittal and with each unit delivered an equipment manual that details the installation, operation, recommended renewal parts list, and maintenance instructions for the specified unit.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Acme Electric, General Electric (ABB), Square D, Eaton, Siemens

2.2 RATINGS

Required kVA, voltages, phases and winding configurations are indicated on the drawings. Transformers must be rated for 60 hertz operation, self-cooled NEMA Class AA and FA, and shall be listed under UL 506 or 1561.

2.3 COILS

A. Windings. Use copper wire (bar stock) for coil windings.

B. Taps. Furnish transformers with full load rated taps in the primary winding as follows:

KVA Rating	Taps
3-15 kVA, single phase; 9-15 kVA, three phase	Two 5 percent taps below rated voltage
25-100 kVA, single phase; 30-300 kVA, three phase	Six 2-1/2 percent taps, four below and two above rated voltage
167-250 kVA, single phase; 500 kVA, three phase	Four 2-1/2 percent taps, two below and two above rated voltage

2.4 INSULATION

Provide a 220°C insulation system which is the manufacturer's standard for a maximum 80°C rise over a 40°C ambient.

2.5 SOUND REQUIREMENTS

Average sound levels must not exceed the following values as measured in accordance with NEMA ST 20-4.12.

kVA	dB
0-9	40
10-50	45
51-150	50
151-300	55
301-500	60

2.6 CONSTRUCTION

A. Enclosure. Unless otherwise specified or indicated, install transformers in metal enclosures designed to provide air cooling and to prevent accidental contact with live conductors.

A. Enclosure. Install transformers with resin-encapsulated coils in totally-enclosed, non-ventilated metal enclosures designed to prevent accidental contact with live conductors.

B. Wiring Compartment. Locate the wiring compartment below the core and coil. Have the compartment cooled by air circulation or insulated from the core and coil with a suitable thermal barrier.

C. Grounding.

1. Ground the core of the transformer to the enclosure with a flexible grounding conductor sized according to NEC requirements.
2. Ground the transformer neutral in accordance with the NEC.

D. Mounting Brackets. Furnish mounting brackets, as required, for wall or structure mounting of transformers rated 45 kVA and less.

PART 3 - E X E C U T I O N

3.1 TAP SETTING

Select the appropriate tap setting on transformer so that the actual secondary voltage is ± 1/2 of a tap span at full load. Record the transformer serial number, kVA rating, selected tap setting and secondary voltage readings. Submit copies of the record to the Architect/Engineer.

3.2 CABLE CONNECTIONS

Make transformer cable connections with compression-type lugs suitable for termination of 75°C rated conductors. Position lugs so that field connections and wiring will not be exposed to temperature above 75°C.

3.3 MOUNTING

A. Floor. Construct concrete pad for floor-mounted transformers in accordance with Section 16050, Electrical General Provisions. Maintain a minimum of 6 inches free air space between enclosure and walls.

B. Wall. Securely anchor wall mounting brackets to wall to provide adequate support.

C. Suspended. Suspend transformers from structure by means of trapeze hangers constructed of galvanized all-thread rods and metal framing channels. Make double-nut connections between rods and channels. Locate to provide adequate ventilation and accessibility.

D. Vibration Isolation. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building or structure.

1. For floor transformer installations, use one pad-type Korfund Elasto-Grip waffle, or accepted substitution, at each corner of the transformer, sized for load of 50 lbs./sq.in.
2. For wall or ceiling hung transformer installations, use spring-type Korfund Series P, or accepted substitution. Provide sound pads at each corner of the transformer, sized for 1/2-inch deflection.
3. Verify removal of shipping brackets before transformer is energized.

E. Ventilation. Provide adequate clearance around transformer for ventilation of core, coil and internal components; minimum 1′-0″ all sides unless noted otherwise.

END OF SECTION

SECTION 16285

SURGE PROTECTIVE DEVICES (SPD) - 600 VOLT AND BELOW

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of Surge Protective Devices (SPD) equipment having electrical characteristics, ratings and modifications as shown on the contract drawings and specified herein.

1.2 REFERENCE STANDARDS

A. The SPD units and all components shall be designed, manufactured, tested and installed in accordance with the latest applicable standards of the following:

1. ANSI/IEEE C62.41 and C62.45.
2. ANSI/IEEE C62.1 and C62.11.
3. National Electrical Manufacturers Association (NEMA LS1 Guidelines).
4. National Fire Protection Association (NFPA 70 [NEC], 75, and 78).
5. Underwriters Laboratories (UL 1449, UL 1283 and UL 845).
6. Underwriters Laboratories (UL 489 and UL 198).

B. The unit shall be UL 1449 Listed and CUL Approved as a Surge Protective Device and UL 1283 Listed as an Electromagnetic Interference Filter.

C. The UL 1449 suppression voltage ratings (SVR) shall be permanently affixed to the SPD unit.

1.3 QUALITY ASSURANCE

The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. A list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.4 SUBMITTALS

A. Submit the following information for review/approval in accordance with Section 01300:

1. Descriptive bulletins.
2. Product sheets.
3. Verification that the SPD device complies with the required UL 1449 and UL 1283 suppression voltage ratings (SVR).
4. Actual let-through voltage test data for both the ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45.
5. UL 1449 Listing/Clamp Voltages. Manufacturer shall provide data showing UL 1449 product listing. Manufacturer shall also submit certified documentation of applicable Location Category Testing in full compliance with NEMA LS 1, paragraphs 2.2.10 and 3.10.
6. Single Pulse Surge Current Capacity Testing. Certified documentation of the unit's NEMA LS-1 Single Pulse Surge Current Capacity Testing shall be included in the submittal.
7. Minimum Repetitive Surge Current Capacity Testing. Certified documentation of the unit's ANSI/IEEE C62.41 and ANSI/IEEE C62.45 Minimum Repetitive Surge Current Capacity Testing shall be included in the submittal.

8. Electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.
9. Test report from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave.

B. Submit the following information for record purposes at closeout:

1. O&M Manual. The manufacturer shall furnish with the submittal and with each unit delivered an equipment manual that details the installation, operation, recommended renewal parts list, and maintenance instructions for the specified unit.
2. Drawings. Electrical and mechanical drawings shall be provided by the manufacturer with the submittal and with each unit delivered that show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit. Include as-built information. Provide drawings with equipment manual.

1.5 EXTENDED WARRANTY

The manufacturer shall provide a full 5-year warranty, which shall initiate after the Owner has accepted the testing results and taken possession of the equipment, against any SPD part failure when installed in compliance with manufacturer's written instructions and applicable national and local electric codes.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Same manufacturer as Section 16455 Motor Control Centers and panelboards.

2.2 SURGE PROTECTIVE DEVICES - GENERAL

A. Surge Protective Devices (SPD) equipment shall meet all ratings and features specified herein.

B. Electrical Requirements.

1. Unit Operating Voltage. Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV). The MCOV shall be greater than 115% of the nominal system operating voltage.
3. Operating Frequency. Range shall be 47 to 63 hertz.
4. Protection Modes. For a wye configured system, the device shall have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta configured system, the device shall have suppression elements between line to line (L-L) and line to ground (L-G).
5. UL 1449 2nd Edition SVR. The maximum UL 1449 2nd Edition suppression voltage ratings (SVR) for the device shall not exceed the following:

Models	208Y/120	480Y/277
L-N, L-G, N-G	400V	800V
L-L, L-G	800V	1500V

6. ANSI/IEEE Cat C3 Let-Through Voltage. The let-through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:

Models	208Y/120	480Y/277
L-N	533V	963V

7. ANSI/IEEE Cat. B3 Let-Through Voltage. Let-through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3/C1 ringwave (6 kV, 5000 amps) shall be less than:

Models	208Y/120	480Y/277
L-N	437V	843V

8. Surge Current Capacity. Total surge current per phase (based on an 8x20 microsecond waveform) that the device is capable of surviving shall not be less than value listed below for each piece of equipment.

SPD Exposure	Surge Current Capacity per Phase
High	300 KA
Medium	200 KA
Low	160 KA

9. Withstand. Each unit must be capable of surviving the following without failure degradation (>10%):

a. Motor Control Centers and Distribution Panelboards. 20,000 ANSI/IEEE C62.41 Category C3 (20 kV, 10 kA), 300 KA surge current capacity.

b. Branch Circuit Panelboards. 5,000 ANSI/IEEE C62.41 Cat. C3 (20 kV, 10 kA), 200 KA surge current capacity for 480V panelboards and 160 KA surge current capacity for 208 or 240V panelboards.

10. Let-through voltage results shall be measured at the service entrance lugs.

C. SPD Design.

1. High Performance Suppression System. Include an engineered solid-state high performance suppression system metal oxide varistors. The suppression system shall not incorporate components which may degrade performance or long-term reliability of the suppression system. Suppression system shall reduce transient levels and provide protection for sensitive electronics susceptible to catastrophic or long-term damage.

2. Electrical Noise Filter. Include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be greater than or equal to 44 dB at 100 kHz using the MIL-STD-220A insertion loss test method. The unit shall be complementary listed to UL 1283.

3. Internal Connections. No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance copper conductors and compression fittings.

4. Remote Status Monitor. The SPD device shall include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state upon detection of a fault condition.

5. Thermal Protection. Each suppression MOV shall be provided with thermal detection circuit to protect from overheating due to thermal runaway.

6. Diagnostics. Provide unit with following diagnostic features:

a. Audible alarm with silence, reset and test feature.

b. Indicator lights per phase.

c. System fault indicator (service indicator).

d. Surge counter.

7. Disconnecting Means. Provide circuit breaker or disconnect for servicing of SPD unit.

2.3 FACTORY TESTING

Each unit shall be thoroughly factory tested before shipment. Testing of each unit shall include but shall not be limited to UL manufacturing and production-line tests, quality assurance checks, MCOV and clamping voltage verification tests. All tests shall be in accordance with the latest version of NEMA and UL standards.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. All SPD's shall be integrally installed inside the motor control centers and panelboards at the manufacturer's factory.

B. Panelboard and motor control center installed units shall be circuit breaker protected.

C. Provide SPD's on motor control centers and distribution panelboards as indicated on one-line diagrams. Provide SPD's on branch circuit panelboards as indicated on panel schedules.

END OF SECTION

SECTION 16370

VARIABLE FREQUENCY DRIVES -
480V MOTORS LESS THAN 100 HP

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Provide labor, equipment, supervision and materials for installation, testing, and startup of the variable frequency drives (VFDs) as shown on the Drawings and as specified herein.

B. Provide a factory-trained technician to startup each VFD. The technician shall be present during the field acceptance testing. Startup service shall include overtime charges, travel, and living expenses and replacement parts.

C. The VFD manufacturer shall provide in writing that the motor to be used is suitable for use with the VFD. He shall obtain motor data from the pump manufacturer or the contractor.

1.2 SUBMITTALS

A. Submit in accordance with Section 01300, shop drawings and product data, for the following:

1. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, dimensions, weight, shipping splits, conduit entrances, and anchor bolt pattern. Indicate all options, special features, ratings and deviations from the specifications.
2. Power and control schematics including external connections. Show wire and terminal numbers and color-coding.
3. Drive performance specifications.
4. Instruction and replacement parts books.
5. As-built final drawings.
6. Field test and inspection reports.

B. Submit the following information for record purposes at closeout:

1. O&M Manual. The manufacturer shall furnish with the submittal and with each unit delivered an equipment manual that details the installation, operation, recommended renewal parts list, and maintenance instructions for the specified unit.

1.3 REFERENCE STANDARDS

A. IEEE Standard 519 - 1992 IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

B. NFPA 70 National Electrical Code (NEC).

1.4 QUALITY ASSURANCE

A. Variable frequency drives shall utilize a field proven design. The VFD manufacturer shall demonstrate at least 3 years of continuous field operating experience with equipment of similar size and design.

B. A factory authorized service and parts organization shall be located within 200 miles of the project location. Provide the name and address of the factory authorized service and parts organization nearest to the project location as part of the shop drawings.

C. Equipment shall be UL labeled.

1.5 SYSTEM DESCRIPTION

Refer to other sections for operation of the VFD, VFD control circuitry and input and output signals connected to the VFD.

1.6 DELIVERY, STORAGE AND HANDLING

A. Package the equipment for maximum protection during delivery and storage.

B. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. At all times, always protect the equipment from exposure to moisture, chemicals, ammonia and chlorine gas.

1.7 PROJECT/SITE REQUIREMENTS

A. VFD shall meet or be less than the following harmonic limits at the point of common coupling (PCC) when the VFDs are operating anywhere in the 60% - 100% speed range under actual pumping conditions.

B. Voltage: 5% total harmonic distortion (THD) per IEEE 519-1992.

C. Current: limits allowed by Table 10.3 of IEEE 519-1992 for $20 < I_{SC}/I_L < 5$.

D. Manufacturer shall submit mathematical analysis to demonstrate that VFDs meet the harmonic limits stated herein. Mathematical analysis shall be a part of the shop drawing submittal. Filters, line reactors, isolation transformers, etc., active which are suitable for outdoor application, shall be supplied by VFD manufacturer if required to meet the harmonic limits. Detailed characteristics of the plant electrical system shall be supplied to the VFD mfr. by the Contractor. Compliance with the harmonic limitations shall be verified by field acceptance testing by the contractor after the VFDs are installed. Refer to Part 3 of this specification for field acceptance testing requirements. All additional wire and conduit to connect the filters shall be furnished and installed by the manufacturer/contractor.

E. For available short circuit current at the point of common coupling.

F. The VFD shall not produce motor noise in excess of the manufacturers published noise standards for 60 Hz operation.

1.8 OPERATING INSTRUCTION

A. After approval, during and after construction, operating manuals covering instruction and maintenance on each type of equipment shall be furnished.

B. The instructions shall be bound and shall provide at least the following as a minimum:

1. A comprehensive index.
2. A complete "as-built" set of approved shop drawings.
3. Detailed service, maintenance and operation instructions for each item supplied.

4. A table listing of the "as left" drive set up parameters and alarm and trip settings.
5. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
6. Complete parts list with stock numbers, including spare parts.

1.9 WARRANTY

Manufacturer shall provide a one-year warranty from the time manufacturer's startup services are completed. Warranty shall include all parts and labor to troubleshoot and replace failed devices.

1.10 TRAINING

Provide one four-hour training class for the Owner's employees covering the operation, maintenance and troubleshooting of the VFDs. Class shall be at the plant and the Owner shall be allowed to videotape the class.

PART 2 - P R O D U C T S

2.1 VARIABLE FREQUENCY DRIVE

A. Manufacturers.

1. Stand Alone Enclosure or Vendor Furnished Control Panel: Schneider Electric (Square D), ABB, or approved equal.
2. MCC Installed: Same manufacturer as Section 16455 Motor Control Centers.

B. Rating.

1. Service Conditions.
   a. Input power: 460 VAC, plus 10 percent, minus 10 percent, 3 Phase, 60 Hz.
   b. Input frequency: 57 to 63 Hz.
   c. Ambient temperature: 0 to 40 degrees C.
   d. Elevation: Up to 3300-ft above mean sea level.
   e. Relative humidity: Up to 95 percent noncondensing.
2. Minimum drive efficiency: 98 percent.
3. Displacement power factor: greater than 95 percent or higher but not leading throughout the entire speed range, measured at drive input terminals. Provide additional power factor correction capacitors if required.
4. Drive output: 100 percent rated current continuous, suitable for operation of the driven equipment over the required speed range without overloading. Drives shall be cable of 120% current overload for one minute. Starting torque shall be matched to the load.
5. Voltage regulation: plus or minus 1 percent of rated value, no load to full load.
6. Output frequency drift: No more than plus or minus 0.5 percent from setpoint.
7. Drives shall withstand five-cycle transient voltage dips of up to 30 percent of rated voltage without an undervoltage trip or fault shutdown, while operating a variable torque load.

C. Construction.

1. General. The general arrangement of the equipment is shown on the Drawings. All drives shall be six-pulse design with integrated or discrete 5% minimum harmonic filtering.
2. The VFDs shall utilize a pulse width modulated space vector design to convert the fixed AC input to a variable voltage, variable frequency AC output. Construction shall be modular, using plug-in-type component mounting or keyed ribbon cable connections wherever possible to minimize downtime during repair.

3. The VFD operate satisfactorily when connected to a bus supplying other solid-state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when other VFDs are operating from the same bus. The drive shall include transient voltage suppression to allow reliable operation on a typical commercial power distribution system.
4. The VFD shall consist of one or more full-wave diode bridge converter(s) to convert incoming fixed voltage/frequency to a fixed DC voltage. The diode bridge frontends shall be 6 pulse diode bridge.
5. Provide a DC link choke smoothing reactor to limit fault throughput. The PWM strategy shall be of the space-vector-type implemented through a microprocessor which generated a sine-coded output voltage.
6. The output shall be generated by power transistors which shall be controlled by six identical, optically isolated base driver circuits. The VFD shall have an output voltage regulator to maintain correct output Volt/Hz despite incoming voltage variations. The VFD shall have a continuous output current rating equal to or greater than the motor full load nameplate current.
7. Each VFD shall have a fused disconnect switch type main power disconnect switch, with an external operating handle. The fuses shall have a short circuit rating of 200,000 Amps, RMS symmetrical and shall be labeled in accordance with UL 489.

D. Provide the following safety features:

1. Provision to padlock main disconnect handle in the OFF position.
2. Mechanical interlock to prevent opening cabinet door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.
3. Barriers and warning signs on terminals that are energized with the power disconnect OFF.
4. Provide an equipment ground bus or lug connectors in each enclosure, suitable for connection to the copper grounding conductors shown on the Drawings.

E. The VFD manufacturer shall evaluate the location of the motor in reference to the VFD and shall furnish and install necessary reactor inside the VFD enclosure to mitigate the reflected walls.

F. Operator Interface.

1. Provide a door-mounted digital keypad/display, capable of controlling the drive and setting drive parameters. The digital display shall normally display:
   a. Speed demand in percent.
   b. Output current in amperes.
   c. Frequency in Hz.
   d. Control mode - manual or automatic.
2. The digital keypad shall allow operators to enter exact numerical settings in English engineering units. A user menu shall be provided as a guide to parameter settings. Coded messages on keypad will not be acceptable. Parameters are to be factory set in EEPROM and resetable in the field. Parameters shall be password protected. The EEPROM stored variables shall be transferable to new and spare boards.
3. The keypad/display module shall have a key switch to control operation of the keypad. The key shall be removable in either the "Enabled" or "Disabled" positions. The keypad module shall contain a "self-test" software program that can be activated to verify proper keypad operation. The keypad display shall contain a full alphanumeric character set.
4. The following controls and indicators shall be provided, either separately or as part of the keypad/display:
   a. POWER ON, RUN AND FAULT indication.
   b. FAULT RESET control.
   c. MANUAL-AUTO control mode selector.
   d. Manual START/STOP controls.
   e. Manual speed adjust capability.
5. Auxiliary Contacts. Three output status relays.

6. Marking and Identification.
   a. Provide 1-in by 3-in, nominal, engraved lamicoid equipment nameplates on each VFD fastened with stainless steel screws or rivets. Nameplates shall be black with white core, 3/8-in high lettering.
   b. Provide permanent warning signs as follows.
      1) "Warning-Hazard of Electric Shock - Disconnect power before opening or working on this unit" on main power disconnect.

G. Protective and Operational Features.

1. Make provisions for field adjustment of the following parameters through the keypad/display:
   a. Current limit and boost.
   b. Voltage (Volts/Hz)
   c. Frequency (Minimum/Maximum)
   d. Independently adjustable acceleration and deceleration rates.
   e. Auto restart delay.
2. Provide the following short circuit and input protective features.
   a. High speed current limiting input fuses and line reactors.
   b. Solid state instantaneous over current trip.
   c. Undervoltage protection with automatic restart.
   d. Ground fault protection.
3. Provide the following internal protective features.
   a. Transient surge protection.
   b. Transistor over current protection.
   c. Current limit, inverse time type.
   d. DC bus fuse protection and discharge circuit.
   e. DC bus overvoltage trip.
4. Provide the following output protective features: Inverse time motor overload protection.
5. Provide all necessary control relays, timers, indicating lights, etc. as shown on the drawing. All these devices shall be installed in the VFD enclosure.

H. Diagnostic and Fault Capability.

1. The following conditions shall cause an orderly drive shutdown and lockout.
   a. Incorrect phase sequence.
   b. Blown input fuse or single phasing of supply.
   c. Control power supply failure.
   d. Instantaneous over current.
   e. Sustained overload.
   f. Transistor over current.
2. Provide complete built-in diagnostic and test capability to enable maintenance personnel to rapidly and accurately identify the cause of equipment failure.

I. Surface Preparation and Shop Coatings.

1. All non-current carrying metal parts of the equipment cabinet shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.
2. Equipment shall be finish painted with one coat of manufacturer's standard electrocoated, heat cured enamel.
3. All device contacts shall be silver cadmium plated.

J. Shop Testing. Perform manufacturer's standard production testing and inspection.

2.2 ENCLOSURE

Install the VFD in a free standing NEMA 12 painted steel cabinet, or in motor control centers as indicated on the drawings.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install the equipment in accordance with the manufacturer's instructions.

B. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.

3.2 FIELD TESTING

A. Provide all testing and recording instruments as part of the field-testing, at no extra cost to Owner.

B. Make the following minimum test and checks before the manufacturer's representative is called in for testing and adjustment.

1. Verify that all connections are completed in accordance with shop drawings.
2. Verify supply voltage and phase sequence are correct.
3. Check mechanical interlocks for proper operation.
4. Test ground connections for continuity and resistance.
5. Check control circuit interlocking and continuity.
6. Test each drive through the specified speed ranges and for a minimum of two hours.
7. Test each drive by using the actual control signals for remote and local operations.

3.3 Test each drive alarm functions.

A. Retain a qualified representative of the manufacturer for a minimum period of 8 hours per variable speed drive to perform the following services:

1. Equipment installation
2. Inspect the completed installation and note deficiencies.
3. Be present and assist the CONTRACTOR during startup, adjusting, and field-testing of the completed installation.
4. Furnish all test forms and procedures for field-testing.
5. The manufacturer’s representative shall revisit the job site as often as necessary until the installation is entirely satisfactory to the Owner.

B. Additional site visits shall be provided at no additional expense to the Owner.

C. In the event of an equipment fault, notify the ENGINEER immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the CONTRACTOR, the ENGINEER, and the equipment manufacturer’s factory service technician. Repair or replace the equipment as directed by the Owner.

D. After startup, the manufacturer/contractor shall perform field acceptance testing which shall measure the harmonics generated at the point of common coupling (PCC). Refer to the following testing for each drive.

E. After operating for one hour at maximum speed and load imposed by the driven equipment, reduce speed in 6 equal increments between 60 hertz and minimum speed.

F. Using the power recorder, record the resultant fundamental and harmonic voltages and currents and the total rms voltage, watts and rms current at both the drive input and at the drive output to the motor at each operating point.

G. Using the power recorder, record the voltage waveforms at the motor terminals or at the motor disconnect, if the disconnect is located within 10 feet of the motor. Demonstrate that the peak value of the wave form does not exceed 1000 volts.

H. If the peak voltage does exceed 1000 volts then adjustments or modifications to the variable speed drive shall be made to remedy the situation.

I. Repeat field-testing and adjustment of the variable speed drive unit until the requirements are met.

J. Submit copies of the reports and graphs generated during the testing which show compliance with the specifications.

K. If the harmonics are not within the limits of the IEEE-519, the manufacturer shall install all necessary filters required and the manufacturer shall bear all costs for the design, manufacture and installation of the filters. The above test shall be resumed to prove IEEE-519 compliance.

3.4 ADJUSTMENT

Make all VFD internal adjustments and all adjustments necessary for manual and automatic operation of the entire system of driven equipment.

3.5 CLEANING

Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION

SECTION 16410

ENCLOSED SAFETY SWITCHES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision and installation of enclosed safety switches.

1.2 REFERENCE STANDARDS

A. ANSI/UL 98 - Enclosed and Dead-Front Switches.

B. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches.

1.3 SUBMITTALS

Provide product data on each type and rating of switch.

PART 2 - P R O D U C T S

2.1 MANUFACTURER

A. Schneider Electric (Square D), Eaton, General Electric (ABB), Hubbell, Klockner-Moeller, Siemens, Appleton

B. Same manufacturer as Section 16455 Motor Control Centers

2.2 CHARACTERISTICS

A. Voltage. Provide switches with a voltage rating of 250 volts d-c, 240 volts or 600 volts a-c, as required for the installed system voltage.

B. Type. Provide switches conforming to NEMA KS 1 standard for Type HD (heavy duty).

C. Contacts. Provide switches with quick-make, quick-break contacts.

D. Poles. Unless otherwise shown, provide 3-pole, visible blade switches.

2.3 CONSTRUCTION

A. Enclosure. Provide Type 316 Stainless Steel NEMA 4X switch enclosures for indoor and outdoor locations unless otherwise shown.

B. Operating Handle. Provide a handle suitable for padlocking in the OFF position with as many as three padlocks of 5/16-inch diameter shank. Use a defeatable, front accessible, coin-proof door interlock to prevent opening the door when the switch is in the ON position and to prevent turning the switch ON when the door is open.

C. Terminal Shield. Provide incoming line terminals with an insulated shield so that no live parts are exposed when the door is open.

D. Neutral. Provide each switch with an isolated, fully rated neutral block. Make provisions for bonding the block to the enclosure.

E. Ground. Provide each switch with a ground lug.

F. Fuse Holders. Where fusible switches are shown, provide switches with rejection-type fuse holders which are suitable for use with fuses specified under Section 16490, Fuses - 600 Volt and Below.

G. Nameplates. Provide metal nameplates, front cover mounted, that indicates the switch type, catalog number and horsepower rating (with both standard and time delay fuses).

2.4 LISTING

UL 98 - Safety Standard for Enclosed Switches.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

Install switches where indicated on drawings. In general, mount so that operating handle is approximately 60 inches above finished floor. Where grouped, align tops of switches.

END OF SECTION

SECTION 16414

TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes automatic transfer switches rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Single-Line Diagram: Show connections between transfer switch, power sources, and load.

1.3 INFORMATIONAL SUBMITTALS

A. Source quality control reports.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 99.

D. Comply with NFPA 110.

E. Comply with UL 1008 unless requirements of these Specifications are stricter.

F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
2. Short-time withstand capability for three cycles.

H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

K. Service-Rated Transfer Switch:

1. Comply with UL 869A and UL 489.
2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
3. In systems with a neutral, the bonding connection shall be on the neutral bus.
4. Provide removable link for temporary separation of the service and load grounded conductors.
5. Surge Protective Device: Service rated.
6. Service Disconnecting Means: Externally operated, manual mechanically actuated.

L. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
1. Ammeter to display charging current.
2. Fused ac inputs and dc outputs.

M. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via front access.

N. Enclosures: General-purpose NEMA 250, Type 1 or 12, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Provide generator and transfer switch from single source.

B. Comply with Level 1 equipment according to NFPA 110.

C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: Hard-drawn copper, 98 percent conductivity.
6. Main and Neutral Lugs: Mechanical type.
7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
8. Ground bar.
9. Connectors shall be marked for conductor size and type according to UL 1008.

D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

E. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to

F. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

G. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
2. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:

    a. Overvoltage.
    b. Undervoltage.
    c. Loss of supply voltage.

d. Reduction of supply voltage.
e. Alternative supply voltage or frequency is at minimum acceptable values.
f. Temperature rise.
g. Dielectric voltage-withstand; before and after short-circuit test.
h. Overload.
i. Contact opening.
j. Endurance.
k. Short circuit.
l. Short-time current capability.
m. Receptacle withstand capability.
n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.

1. Install transfer switches on cast-in-place concrete equipment base(s).
2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
3. Provide workspace and clearances required by NFPA 70.

B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.

C. Identify components according to Section 260553 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets,control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 16130 "Raceways" and 16135 "Boxes."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

D. Ground equipment according to Section 16060 "Grounding."

E. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visual and Mechanical Inspection:

a. Compare equipment nameplate data with Drawings and Specifications.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and required clearances.
d. Verify that the unit is clean.
e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Verify that manual transfer warnings are attached and visible.
g. Verify tightness of all control connections.
h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

i. Perform manual transfer operation.
j. Verify positive mechanical interlocking between normal and alternate sources.
k. Perform visual and mechanical inspection of surge arresters.
l. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

2. Electrical Tests:

a. Perform insulation-resistance tests on all control wiring with respect to ground.
b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
c. Verify settings and operation of control devices.
d. Calibrate and set all relays and timers.
e. Verify phase rotation, phasing, and synchronized operation.
f. Perform automatic transfer tests.
g. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

4. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

B. Coordinate tests with tests of generator and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Transfer switches will be considered defective if they do not pass tests and inspections.

E. Remove and replace malfunctioning units and retest as specified above.

F. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 16425

MOTOR STARTERS - 600 VOLT AND BELOW

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision and installation of individual motor starters rated 600 volts and below.

1.2 QUALITY ASSURANCE

A. Reference Standards.

1. NEMA ICS - Industrial Controls and Systems.
2. NFPA 70 - National Electrical Code (NEC).
3. UL 508 - Industrial Control Equipment.

B. Qualifications. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.3 SUBMITTALS

Provide product data, including the following:

A. Ratings including:

1. Voltage.
2. Horsepower and/or continuous current.

B. Dimensioned outline drawings.

C. Conduit entry/exit locations.

D. Cable terminal sizes.

E. Wiring diagrams.

1.4 SPARES

Provide the greater of 10 percent or three spare fuses for each size and type fuse used in the installed equipment.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Same manufacturer as Section 16455 Motor Control Centers.

2.2 MAGNETIC MOTOR STARTER

A. Type. Provide magnetic, full-voltage, nonreversing, across-the-line motor starters unless otherwise indicated. Where reversing starters are shown, provide factory assembled and wired unit with interlocked forward and reverse contactors. Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation. Starters shall be electrically and mechanically interlocked to prohibit both starters from being energized simultaneously.

B. Overload Relay - Bimetallic. Provide in each phase leg an ambient compensated, bimetallic type thermal overload relay (TOL) with interchangeable thermal units.

C. Contactor. Size contactors according to NEMA standards or as shown. Provide main pole in each phase leg, the number and type of auxiliary contacts to perform the required functions, and two spare auxiliary contacts, one normally open and one normally closed. Use double break contacts of silver-cadmium oxide or similar material to minimize sticking or welding. Provide contactor coils suitable for continuous operation at 120 volts, 60 hertz.

D. Control Power Transformer.

1. Voltage. Provide in each enclosure a single-phase control power transformer with a 480-volt primary and a 120-volt secondary.
2. Fuses. Fuse both primary lines of the transformer and connect to Line 1 and Line 2. Fuse the secondary line leaving transformer terminal X1. Ground the line leaving terminal X2. Use rejection-type fuse clips and RK-1 type current limiting fuses on the primaries. Coordinate primary fuses with secondary fuse to clear a faulted transformer but not blow on magnetizing inrush current.
3. Size. Provide manufacturer's standard size transformer unless noted otherwise on the drawings.

E. Enclosure. Provide Type 316 Stainless Steel NEMA 4X enclosures, unless otherwise indicated on drawings.

2.3 COMBINATION CIRCUIT BREAKER-STARTER

A. Type. Provide combination circuit breaker and magnetic motor starter as indicated on the drawings.

B. Thermal-Magnetic Circuit Breaker. Where indicated on drawings, provide circuit breaker which is quick-make and quick-break on both manual and automatic operation. Provide a trip-free breaker which is trip indicating. Incorporate inverse time characteristic by bimetallic overload elements and instantaneous characteristic by magnetic trip. For 2-pole and 3-pole breakers, provide the common-trip type so that an overload or fault on one pole will trip all poles simultaneously.

C. Operators. Provide switch operators mounted through the panel door and permitting operation of the switch with the door closed. Operators shall be capable of being padlocked in the OPEN or OFF position with as many as three padlocks of 5/16-inch diameter shank. Use a defeatable, front-accessible, coin-proof, mechanical, door interlock to prevent opening the door when the operator is in the CLOSED or ON position, and to prevent placing the operator in the CLOSED or ON position when the door is open.

D. Starter. Provide magnetic motor starter as specified in paragraph 2.2.

E. Control Devices. Control devices are furnished with vendor furnished control panels in other specification sections unless indicated otherwise. As a minimum provide control power transformer and motor space heater control functions.

2.4 CONTROL DEVICES

Provide the following control devices for each starter as required to meet the criteria defined in appropriate sections of Division 11.

A. Selector Switches. Heavy-duty, oil-tight, maintained contact, 3-position, with marked nameplate HAND-OFF-AUTOMATIC, unless otherwise indicated.

B. Pushbuttons. Heavy-duty, oil-tight, momentary contact with marked nameplate START-STOP, unless otherwise indicated.

C. Indicating Lights. Pilot light assemblies shall be heavy-duty, oil-tight, push-to-test, transformer-type, long-life, high-density light-emitting diode (LED) type. Incandescent or neon lamps are not acceptable. Provide red (running) and green (stopped) LED lamps with clear or matching color lenses. On two-speed starters, provide amber (low speed), red (high speed) and green (stopped) lenses.

D. Instrumentation Control Interface Equipment. The Contractor shall furnish and install all necessary equipment and devices including but not limited to control contacts, switches, terminal boards, conduit and control wiring for the proper operation of the equipment. The Contractor shall verify with the equipment manufacturer all required equipment and devices for the operation of the Starter. The Contractor shall furnish and install all equipment and devices as shown on the Instrumentation Drawings required for the control and monitoring of the equipment.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

Install units where indicated on the drawings. In general, mount combination units so that operating handle is approximately 44 inches above finished floor. On non-combination units, mount so that control device is approximately 44 inches above finished floor. Where grouped, align tops of units. Provide housekeeping pads for freestanding and floor-mounted units, as specified in Section 16050.

3.2 OVERLOAD SETTINGS

Set overload relays at maximum values permitted by NEC 430-32, based on actual installed motor nameplate full load amperes. Coordinate overload settings with NEC 460-9 requirements where power factor correction capacitors are provided.

3.3 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist in installation and start-up of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.

B. The following minimum work shall be performed under the technical direction of the manufacturer's service representative.

1. Inspection and final adjustments.
2. Operational and functional checks of controllers/starters and spare parts.

C. Provide copies of the manufacturer's field start-up report to the Engineer.

END OF SECTION

SECTION 16442

PANELBOARDS - DISTRIBUTION AND BRANCH CIRCUIT

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of distribution and branch circuit panelboards.

1.2 REFERENCE STANDARDS

A. ANSI/UL 50 - Cabinets and Boxes.

B. ANSI/UL 67 - Electric Panelboards.

C. ANSI/UL 508 - Industrial Control Equipment.

D. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

E. NEMA AB 3 - Molded Case Circuit Breakers and Their Application.

F. NEMA PB 1 - General Instructions for Proper Handling, Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

G. NFPA 70 - National Electrical Code (NEC).

1.3 SUBMITTALS

A. Provide product data on panelboards and circuit breakers.

B. Provide shop drawings with a schedule for each panelboard which indicates the circuit breaker arrangement and other pertinent features. Panelboard schedules must be identical to the schedules in the project documents unless there is a technical reason there must be a deviation. Submitted panelboard schedules must also contain confirmation of panelboard characteristics.

C. Shop drawings shall also provide the following information:

1. Breaker layout drawing with dimensions indicated and nameplate designation.
2. Component list.
3. Assembly ratings including:
   a. Short-circuit rating.
   b. Voltage.
   c. Continuous current.
4. Cable terminal sizes.

1.4 QUALITY ASSURANCE

The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.

PART 2 - P R O D U C T S

2.1 MANUFACTURER

A. Same manufacturer as Section 16455 Motor Control Centers.

2.2 ENCLOSURE

A. Cabinet. Construct cabinets in accordance with UL 50. Construct boxes with corrosion resistant, zinc finish galvanized steel. Provide a minimum 4-inch gutter wiring space on each side. Reinforce cabinets and securely support bus bars and overcurrent devices to prevent vibration and breakage in handling. Provide cabinets without conduit knockouts. All conduit knockouts shall be made in the field. Surface-mounted panelboards in finished spaces shall have cabinet finishes to match doors and trim as specified below. In unfinished areas such as mechanical and electrical rooms, galvanized sheet steel cabinets are sufficient, provided galvanizing occurs after components are cut or sheared.

B. Doors and Trim.

1. Interior Dry Locations. Fabricate doors and trim of "door-in-door" construction. The outer door shall have a continuous piano hinge on the right side and shall provide full access to the cabinet interior. The inner door shall have a continuous piano hinge on the right side and shall provide access only to circuit breaker operating handles. Fabricate doors and trim of cold-rolled sheet steel. Equip inner doors with flush-type combination catch and key lock. Key all locks alike. Fasten trim for panelboards to cabinets by an approved means which permits both horizontal and vertical adjustment. Trim for surface-mounted panelboards must fit the cabinet with no overhang.
2. Interior Wet and Exterior Locations. Use manufacturer's standard door.
3. Corrosive Locations. Use manufacturer's standard door.

C. Finish. Apply a finish to trim and doors consisting of two coats of enamel over a rust-inhibiting prime coat. Exterior finish shall be gray ANSI 61 paint. Interior finish shall be flat (non-gloss) white.

D. Provide NEMA12 cabinets in interior dry locations. Provide NEMA 3R/12 cabinets in interior wet and exterior locations. Provide stainless steel NEMA 4X in corrosive areas.

2.3 BUS

A. Fabricate phase, neutral and ground buses of 98 percent IACS conductivity tin-plated copper with rounded edges. Size bars as indicated and brace them to withstand symmetrical short circuit current as indicated on drawings. Install buses in allotted spaces so that devices can be added without additional machining, drilling or tapping. Use buses with silver-plated contact surfaces. Include copper neutral and ground buses rated not less than the phase bus ampacity.

B. Where isolated ground buses are specified or indicated, provide tin-plated copper grounding busbars and copper/aluminum rated lugs mounted in the panelboard on insulated standoffs to ensure isolation from equipment ground potential. Isolated ground buses shall be drilled and tapped as appropriate for connection of the individual isolated grounding conductors.

2.4 PROTECTIVE DEVICES

Provide circuit breakers for the specified service with the number of poles, ampere and short circuit ratings indicated on panelboard schedules.

A. Provide breakers which are quick-make and quick-break on both manual and automatic operation. Use a trip-free breaker which is trip indicating. Incorporate inverse time characteristic by bimetallic overload elements and instantaneous characteristic by magnetic trip. Where indicated, provide ground fault interrupters (GFCI).

B. For 2-pole and 3-pole breakers, use the common-trip type so that an overload or fault on one pole will trip all poles simultaneously. Handle ties are not acceptable.

C. Unless otherwise indicated on panelboard schedules, provide circuit breakers with the following minimum interrupting ratings:

1. 22,000 rms symmetrical amperes at rated voltage for breakers rated 120/208, single pole, or 208 volts, multipole.
2. 25,000 rms symmetrical amperes at rated voltage for breakers rated 277 volts, single pole, or 480 volts, multipole.

D. Connect breakers to the main bus by means of a solidly bolted connection. Use breakers which are interchangeable, capable of being operated in any position within the panel. Independently mount breakers so that a single unit can be removed from the front of the panel without disturbing or removing main bus, other units or other branch circuit connections.

E. Cable lugs shall be copper/aluminum rated.

2.5 CIRCUIT IDENTIFICATION

For each panelboard, provide a steel directory frame mounted inside the door with a heat-resistant transparent face and a directory card for identifying the loads served. Type directory as specified in Section 16052.

2.6 LISTING

UL 67 - Electric Panelboards.

2.7 SURGE PROTECTIVE DEVICE (SPD)

Provide integral SPD per Section 16285, Surge Protective Devices (SPD) - 600 Volt and Below.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install panelboards in the locations as shown and as recommended in NEMA PB1.

B. Install the panelboards such that the center of the switch or circuit breaker in the highest position will not be more than 6-1/2 feet above the floor or working platform.

3.2 PROTECTION

A. Temporary Doors. Panelboard cabinets shall be protected by a temporary door until the panelboard is energized. Temporary doors shall be 1/4-inch-thick plywood or equivalent rigid material. Temporary doors shall be installed when the cabinet is installed and shall remain closed at all times except when work is being performed inside the panelboard.

B. Permanent Doors and Trim. Permanent doors and trim shall be installed immediately before panelboards are energized. Permanent doors and trim shall be maintained in factory condition after installation. Doors shall remain closed at all times except when the panelboard is deenergized and work is taking place within the panelboard.

C. Cabinets. Cabinet interiors shall be maintained "white glove" clean at all times. Cabinet exteriors shall be maintained free of mud, spray-on insulation, paint spray and all substances not placed on the exterior surface by the panelboard manufacturer.

END OF SECTION

SECTION 16445

MOTOR CONTROL CENTERS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section includes the requirements for the provision of motor control centers for use on 3-phase power systems rated 600 volts and below, and which conform to NEMA Type 1B-D wiring, Type NEMA 12/3R construction.

1.2 QUALITY ASSURANCE

A. Reference Standards. Design, test, assemble and install in conformance to the latest edition of the following applicable industry standards, where applicable.

1. ANSI C19 - Industrial Control Apparatus.
2. ANSI/NEMA ICS1 - General Standards for Industrial Control and Systems.
3. ANSI/NEMA ICS2 - Industrial Control Devices, Controllers and Assemblies.
4. ANSI/NEMA ICS4 - Terminal Blocks for Industrial Use.
5. ANSI/NEMA ICS6 - Enclosures for Industrial Controls and Systems.
6. NEMA AB1 - Molded Case Circuit Breakers.
7. NEMA PB1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
8. NEMA PB1.2 - Application Guide for Ground Fault Protective Devices for Equipment.
9. NFPA 70 - National Electrical Code (NEC).
10. UL 467 - Standard for Safety, Grounding and Bonding Equipment.
11. UL 489 - Standard for Safety, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures.
12. UL 506 - Standard for Safety, Specialty Transformers.
13. UL 508 - Industrial Control Equipment.
14. UL 845 - Electric Motor Control Centers.

B. Qualifications. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.3 SUBMITTALS

A. Provide product data, including the following:

1. Ratings, including voltage and horsepower or continuous current.
2. Cable terminal sizes.
3. Short circuit current ratings.

B. Dimensional Drawings. Submit dimensional drawings of the motor control center, including top and bottom views showing entry and exit space for conduits and busways, front and side elevations showing arrangement of all devices, and busway connection details. Also include dimensional data on all buses including material type and capacity of the buses.

C. Wiring Diagrams. Power, signal, and control wiring for class and type of motor control center. Provide schematic wiring diagram for each type of controller.

D. Electrical Information. Submit one-line diagrams for equipment being provided. Also submit information on all protective devices including type, ratings, and settings of all trips provided, to include ground fault relay settings.

E. Coordination Curves. Manufacturer shall provide coordination curves on log-log paper for the main protective device and for the largest branch circuit devices. These curves shall also show the ground fault protective relay.

PART 2 - P R O D U C T S

2.1 MANUFACTURER

A. Schneider Electric (Square D), General Electric (ABB), Eaton, Siemens, or Rockwell (Allen Bradley.

2.2 DESCRIPTION

A. General. Provide a completely factory assembled motor control center from incoming line lugs to load terminals of all branch protective devices. Include all necessary buses, supports, devices and provisions for future connections as shown on the one-line diagrams and as specified.

B. Size. The physical size and configuration of the motor control center and equipment may be varied to suit the manufacturer's standard design, provided the intended functions are accomplished. Any change in size or configuration must be so noted on the submittal. Any changes made are restricted by Section 16050.

C. Listing.

1. The motor control center shall be UL listed as suitable for use as service entrance equipment.
2. UL 845 - Electric Motor Control Centers.

2.3 ENCLOSURE

A. Construction.

1. Fabricate the enclosure of one or more rigid, freestanding sheet metal cubicles bolted together to form a rigid assembly. Use not less than No. 14 gauge, cold-rolled steel. Grind smooth any imperfections, such as welding splatter, sharp edges, burrs, etc., before finishing.
2. Make each vertical section nominally 20 inches wide, 20 inches deep and 90 inches high, unless noted otherwise.
3. Provide doors with substantial vertical hinges, permitting them to swing out. Provide a defeatable mechanical interlock that prevents door from being opened when disconnecting means is in closed position.
4. Provide a hinged wireway the full height of each vertical section for component wiring installation.
5. Construct the enclosure according to NEMA 12 requirements for interior locations and NEMA 3R gasketed requirements for exterior locations.
6. Provide suitable lifting means to facilitate handling of the motor control center.

B. Component Isolation. Mount each component, such as a fused switch, combination starter, dry-type transformer or branch circuit panel in a separate compartment and effectively isolate from adjacent units, including buses. Make each component readily accessible and removable from the front of the cubicle.

C. Cable Entrance. Make provisions for top and bottom cable entrances.

D. Finish. Grind all interior and exterior steel and aluminum surfaces smooth, with all burrs, sharp edges, welding splatters, loose rust, scale and the like totally removed after fabrication. The finish coat shall consist of ANSI 61 Gray thermosetting polyester powder paint, or acceptable equivalent, applied electrostatically to

pre-cleaned and phosphatized steel and aluminum internal and external surfaces with a minimum 1.5 mil DFT. The coating shall have a minimum corrosion resistance of 300 hours to 5 percent salt spray. Prior to shipment, all switchgear exterior surfaces shall be given a topcoat of ANSI 61 Gray high-gloss enamel with a minimum 1.5 mil DFT. Final interior finish shall be flat white (non-gloss) enamel with a minimum 1.5 mil DFT. The use of galvanized metal for interior or exterior surfaces is not acceptable. Provide a minimum of one quart of finish paint for touch-up after field installation.

2.4 BUS STRUCTURE

A. Materials.

1. Bar. Fabricate buses of 98 percent IACS conductivity tin-plated copper. Use full lap construction and make main bus connections using a minimum of two bolts.
2. Cable. Standard, code grade copper, sized according to the NEC.
3. Bracing. Adequate to withstand mechanical forces exerted during a short circuit directly from a source with an available fault current not less than value indicated on drawings.

B. Main Horizontal Bus.

1. Locate at top and rated as indicated on the drawings.
2. Arrange to permit future extensions.

C. Vertical Buses.

1. Rate as required but not less than 300 amperes.
2. Provide stab isolation shutter mechanisms to isolate and insulate vertical bus and stabs from cubicle enclosures.

D. Ground Bus. Provide a continuous tin-plated copper ground bus for entire length of the enclosure. Arrange to permit future extensions. Ground motor control center parts which do not carry current. Terminations must be of an approved pressure connector type.

2.5 CIRCUIT BREAKERS

A. Type. Provide molded case thermal-magnetic circuit breaker which is quick-make and quick-break on both manual and automatic operation. Provide a trip-free breaker which is trip indicating. Incorporate inverse time characteristic by bimetallic overload elements and instantaneous characteristic by adjustable magnetic trip. For 2-pole and 3-pole breakers, provide the common-trip type so that an overload or fault on one pole will trip all poles simultaneously.

B. Operators. Provide breaker operators mounted through the panel door and permitting operation of the breaker with the door closed. Operators shall be capable of being padlocked in the OPEN or OFF position with as many as three padlocks of 5/16-inch diameter shank. Use a defeatable, front-accessible, coin-proof, mechanical, door interlock to prevent opening the door when the operator is in the CLOSED or ON position, and to prevent placing the operator in the CLOSED or ON position when the door is open.

C. Ratings. As indicated on drawings.

2.6 STARTERS

Provide starters as specified in Section 16425.

2.7 CONTROL RELAYS

Provide industrial control relays as shown on drawings having 120-volt, 60-hertz coils standard convertible NO or NC 10-ampere, 600-volt contacts and building module feature enabling relay to have up to 12 poles.

2.8 TIMING RELAYS

Provide solid-state time-delay type as shown on drawings, having 120-volt, 60-hertz coils, 10-ampere, 600-volt contacts and an adjustable timing range of approximately 0.3 to 30 seconds, unless noted otherwise on the drawings.

2.9 CONTROL WIRING

A. Wiring. Install and test control and small wiring inside the MCCs at the factory, including control wiring, instrument and relay wiring, secondary leads from instrument transformers, etc. Neatly and carefully install wiring in suitable wiring gutters or conduit, using standard 600-volt switchboard type, stranded copper wire No. 14 AWG or larger. Identify each wire at terminals by means of permanent, sleeve-type wire markers. Secure wiring from hinged doors and panels to enclosure in a manner to allow ample flexibility in bending. Make wiring continuous from terminal to terminal, without splices.

B. Terminals. Terminate wire on instruments, devices, transformers and terminal blocks by means of ring-tongue type connectors under screws, marked in accordance with the manufacturer's wiring diagram. Locate terminal blocks in readily accessible places.

C. Spare Contacts. Wire spare contacts to suitably identified terminals for external connections and clearly show these connections on shop drawings.

D. Spare Terminals. In addition to specified spare contact terminals, provide six spare terminals on each terminal block provided.

2.10 NAMEPLATES

A. Main Nameplate. Provide MCC with a stainless steel or equal nameplate prominently displayed on the front, indicating manufacturer's name, address and shop order number, year manufactured, and the following ratings:

1. Nominal voltage rating and frequency.
2. Main bus continuous current rating.
3. Maximum 3-phase rms symmetrical short circuit current rating.

B. Unit Nameplates. Provide each unit with a black-white-black lamacoid nameplate with 3/16-inch-high white lettering secured to front of unit by means of oval-head chrome-plated brass screws, immediately below switch handle. Actual nameplate legend, which may consist of up to three lines, will be provided by the Owner's representative on shop drawings as approved.

C. Caution Signs. Provide caution signs in accordance with OSHA requirements.

2.11 SPD FOR MCC

For the MCC, provide surge protective device conforming to Section 16285, Surge Protective Devices (SPD) – 600 Volt and Below.

PART 3 - E X E C U T I O N

3.1 PREPARATION

Construct a concrete pad in accordance with Section 16050, Electrical General Provisions. Verify dimension of the housekeeping pad and the embedded leveling channels and conduit stub-ups.

3.2 INSTALLATION

A. Install the motor control center in accordance with the manufacturer's published instructions.

B. Torque bus bar bolts to manufacturer's recommendations and tighten nuts and bolts on the steel structure to ensure structural integrity.

3.3 EQUIPMENT ADJUSTMENT

A. Set overload relays at maximum values permitted by the NEC, based on actual installed motor nameplate full load amperes. Coordinate overload settings with NEC requirements where power factor correction capacitors are provided.

B. Adjust the magnetic setting on motor circuit protectors in accordance with motor inrush currents (nameplate data) and NEC requirements.

C. Touch-up Painting. Restore damaged surfaces to factory finish. Deliver to Owner all leftover paint in suitably labeled, sealed containers.

D. Inspection. Thoroughly inspect motor control center for items such as loose connections and presence of foreign material, and remedy prior to energizing.

3.4 TESTING

A. Demonstrate that motor control circuits function properly, as specified, under all required operating conditions.

B. Where units do not function properly, and where possible, the unit shall be corrected onsite and reinstalled. Where the unit cannot be corrected on site, remove and return to the manufacturer for correction or replacement. This shall not relieve the Contractor of the responsibility to complete the installation within the schedule, as stipulated in the contract documents.

C. Retest corrected units to demonstrate proper operation per paragraph 3.4A above.

END OF SECTION

SECTION 16490

FUSES – 600 VOLT AND BELOW

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

This section specifies the furnishing and installation of low voltage fuses rated 600 volts and below, 6000 amperes and below.

1.2 REFERENCE STANDARDS

A. ANSI/NEMA FU 1 - Low Voltage Cartridge Fuses.

B. ANSI/UL 198C - High-Interrupting-Capacity Fuses, Current-Limiting Type.

C. ANSI/UL 198D - Class K Fuses.

D. ANSI/UL 198E - Class R Fuses.

1.3 SUBMITTALS

Provide product data on fuses.

1.4 SPARE FUSES

As spares, provide the greater amount of either three fuses or 10 percent of each size and type installed. Deliver the spare fuses to the Owner at the time of final acceptance of the project. Neatly encase the spare fuses in suitable containers or cabinets.

PART 2 - P R O D U C T S

2.1 ACCEPTABLE MANUFACTURERS

A. Low voltage fuses shall be products of a single manufacturer.

B. Acceptable manufacturers are Bussman, Gould (Shawmut) and Littelfuse.

2.2 VOLTAGE

Provide fuses with a voltage rating suitable for the nominal voltage of the system in which they are to be applied.

2.3 TYPES

A. Time Delay Fuses. Unless otherwise indicated, provide UL Class RK-5-time delay, current limiting fuses having 200,000 rms symmetrical amperes interrupting rating. Use on all 600-ampere or smaller circuits supplying individual motors and transformers, and where otherwise indicated.

B. Non-Time Delay Fuses. Fuses indicated by "K-1" on the drawings are UL Class RK-1 non-time delay having 200,000 rms symmetrical amperes interrupting rating. Use on all 600-ampere or smaller circuits supplying branch circuit panelboards, resistance heating and where otherwise indicated.

C. Class L Fuses. Fuses rated 601-6000 amperes are UL Class L with 200,000 rms symmetrical amperes interrupting rating.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Instructions. Follow the manufacturer's installation instructions.

B. Fuse Clips. Check fasteners on fuse clips for tightness when installing fuses.

C. Labels. Install fuses so label is in an upright, readable position. Fuses without labels are not acceptable.

END OF SECTION

SECTION 16510

LIGHTING FIXTURES AND LAMPS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Section includes the following types of LED luminaires:

1. Linear industrial.

2. Strip light.

3. Surface mount, linear.

4. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.

a. Luminaire supports.

b. Poles and accessories for support of luminaires

1.2 SUBMITTALS

Provide product data on each lighting fixture, type of lamp and poles.

A. Delegated-Design Submittal for exterior lighting pole foundations.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by a qualified professional engineer responsible for their preparation who is currently licensed in the State of Texas.

B. PERFORMANCE REQUIREMENTS FOR EXTERIOR LIGHT POLE FOUNDATIONS

1. In addition to satisfying the requirements of the International Building Code and referenced standards, all lighting foundations shall be designed and detailed by the delegated-design professional to comply with the following requirements:

a. Dead Load: Weight of luminaire and its horizontal and vertical supports, and supporting structure, applied according to AASHTO LTS-6-M

b. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M."

c. Basic Wind Speed, V = 100 mph (3-second gust; ultimate)

d. Wind Directionality Factor, Kd = 1.0

e. Exposure Category = C

f. Importance Factor, I = 1.15

2. Structural Performance: Building appurtenances and other structures shall withstand the effects of gravity and environmental loads without compromising strength and serviceability. Appropriate factors of safety against sliding and overturning shall be ensured through properly designed and detailed positive anchorage of the appurtenance or structure to the supporting structure. Calculations shall be included with the delegated-design submittal.

PART 2 - P R O D U C T S

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter, shape, size, wattage, and coating.

c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

2.2 EXTERIOR LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61.

F. Bulb shape complying with ANSI C79.1.

G. CRI of minimum 80. CCT of 4100 K.

H. L70 lamp life of 50,000 hours.

I. Lamps dimmable from 100 percent to 0 percent of maximum light output.

J. Internal driver.

K. Nominal Operating Voltage: 480/277 V ac.

L. In-line Fusing: [On the primary for each luminaire] [Separate in-line fuse for each luminaire].

M. Lamp Rating: Lamp marked for outdoor use.

N. Source Limitations: Obtain luminaires from single source from a single manufacturer.

2.3 MANUFACTERER

A. Refer to light fixture schedule as shown in drawings for approved manufacturers. Equal substitutions shall be approved.

2.4 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

E. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

F. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.

2. Provide filter/breather for enclosed luminaires.

2.5 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

2.6 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gauge.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug

PART 3 - EXECUTION

3.1 COORDINATION

Install lighting fixtures in accordance with manufacturer's written instructions, NEC and NECA. Before placing order, verify that the lighting fixtures are compatible with the specified ceiling systems as indicated on the drawings. Regardless of the catalog number prefixes and suffixes shown, furnish fixtures with the proper trim, frame, support, hangers, drivers, voltage rating, and other miscellaneous appurtenances to properly coordinate with building conditions. If a fixture type designation is omitted, furnish fixture of the same type as shown for rooms of similar usage. Confirm with Engineer.

3.2 INTERIOR INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning.

3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Fixtures must be completely wired and lamps installed. Lighting fixtures must be operating properly at final completion.

E. Provide hangers and support members for fixtures as required for proper installation. Provide appurtenances which include stud supports, stems, mounting brackets, frames and plaster rings.

F. Support fixtures from the building structure or from furring channels. Furring channels must be a minimum size of 1-1/2 inches. Fixtures in suspended ceilings shall be supported in accordance with NEC 410.16.

G. Flexible metal conduit from junction box to lighting fixture shall not touch the ceiling as finally installed.

3.3 EXTERNAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Install lamps in each luminaire.

C. Fasten luminaire to structural support.

D. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning.

3. Support luminaires without causing deflection of finished surface.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

H. Install luminaires at height and aiming angle as indicated on Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.4 POLE INSTALLATION

A. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

B. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch (25 mm) below top of concrete slab.

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

C. Verify operation of photoelectric controls.

END OF SECTION

ATTACHMENT A

GEOTECHNICAL INVESTIGATION REPORT

Attachment A

GEOTECHNICAL EVALUATION
PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

PREPARED FOR:
Lockwood Andrews & Newnam, Inc.
2925 Briarpark Drive, Suite 400
Houston, Texas 77042

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
2313 West Sam Houston Parkway North, Suite 119
Houston, Texas 77043

June 1, 2017
Project No. 700660001

June 1, 2017
Project No. 700660001

Mr. William Schlafer, PE, PMP
Lockwood Andrews & Newnam, Inc.
2925 Briarpark Drive, Suite 400
Houston, Texas 77042

Subject: Geotechnical Evaluation
Pirates Beach Wastewater Treatment Plant Improvements
Moyenne Place Near Lafittes Point
Galveston, Texas

Dear Mr. Schlafer:

In accordance with our proposal dated March 30, 2017 and the Subconsultant Agreement dated April 13, 2017, Ninyo & Moore has performed a geotechnical evaluation for the above referenced site. The attached report presents our methodology, findings, geotechnical considerations, and recommendations for design and construction of the proposed wet well and treatment structures.

We appreciate the opportunity to be of service to you during this phase of the project.

Sincerely,
NINYO & MOORE

Scott K. Snow, EIT
Graduate Engineer

Richard J. Whitt, PE
Senior Project Engineer



SKS/RJW/SJ/tah

6/1/2017

Distribution: (1) Addressee (via email)

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1. INTRODUCTION

In accordance with our proposal dated March 30, 2017 and the Subconsultant Agreement dated April 13, 2017, we have performed a geotechnical evaluation for the planned improvements to the Pirates Beach Wastewater Treatment Plant in Galveston, Texas (Figure 1). The purpose of our evaluation was to assess the subsurface conditions at the site in order to provide geotechnical recommendations for the design and construction of the project. This report presents the results of our evaluation, geotechnical considerations, and geotechnical design parameters for the proposed wet well and treatment structures.

2. SCOPE OF SERVICES

The scope of our services for this project generally included:

- Reviewing readily available aerial photographs and published geologic literature, including maps and reports pertaining to the project site and vicinity.
- Performing a visual reconnaissance of the site, marking out the boring locations, and notifying Texas811 of the boring locations prior to drilling.
- Drilling, logging, and sampling four exploratory soil borings to depths ranging from about 20 to 45 feet each below the existing ground surface (bgs).
- Performing laboratory tests on selected samples obtained from our borings to evaluate the in-situ moisture content, percent of particles finer than No. 200 sieve, and shear strength.
- Compiling the collected data and performing engineering analyses.
- Preparing an engineering report presenting our findings, geotechnical considerations, and recommendations regarding the design and construction of the project.

Our scope of services did not include environmental consulting services such as hazardous waste sampling or analytical testing at the site. If needed, a scope and fee for these services can be provided.

3. SITE DESCRIPTION

The project is located at the City of Galveston's Pirates Beach Wastewater Treatment Plant located near Moyenne Place and Lafittes Point in Galveston, Texas. The site is bounded to the

north by vacant land, residential development, and mud flats along West Bay, to the east by Lafittes Point, to the south by Moyenne Place, and to the west by vacant land and a canal. At the time of our evaluation, the site was occupied by existing treatment structures and was vegetated with grass.

Based on the *Lake Como, Texas, 7.5-Minute United States Geological Survey (USGS) Topographic Quadrangle Map (2016),* the elevation at the site is about 7 feet relative to mean sea level (MSL). Based on the information presented on this topographic quadrangle map, the site slopes down to the north.

4. PROPOSED CONSTRUCTION

The project consists of the construction of a new lift station and additional treatment structures. We understand the lift station will be no deeper than about 25 feet bgs and will be constructed using the sinking caisson method. Locations and details of the planned treatment structures were not available at the time of our evaluation. However, we understand above-grade structures are planned. We have assumed that structural loads will be typical for these types of structures.

We understand finished grade will match existing and that grading will be minor. If finished grades will vary from existing grades by more than 1-foot, Ninyo & Moore should be contacted to perform a review of the new information and to evaluate the need for additional recommendations.

5. FIELD EXPLORATION

On April 24, 2017, Ninyo & Moore conducted a subsurface exploration at the site in order to evaluate the existing subsurface conditions and to collect soil samples for laboratory testing. Our evaluation consisted of drilling, logging, and sampling four exploratory soil borings, denoted B-1 through B-4 (Figure 2), at locations selected by the Client. Boring B-1 was performed in vicinity of the proposed lift station and extended to a depth of about 45 feet bgs. The three remaining borings were performed in the vicinity of planned treatment structures and extended to about 20

feet each. The borings were performed using a Mayhew tractor-mounted drill rig equipped with straight-flight augers and rotary wash equipment.

Soil samples were collected at selected intervals and were logged in general accordance with American Society of Testing Materials (ASTM) standard D 2488. Relatively undisturbed soil samples were collected at regular intervals by hydraulically pushing Shelby tube samplers. A pocket penetrometer was used to approximate the unconfined compressive strength as an indicator of soil consistency for intact cohesive samples. Disturbed soil samples were collected during Standard Penetration testing using a split-spoon sampler. Brief descriptions of field sampling procedures used are presented on Figure A-1, Explanation of Field Sampling Procedures, in Appendix A. Descriptions of the soils encountered in our borings are presented on boring logs in Appendix A.

6. LABORATORY TESTING

The soil samples collected from our drilling activities were transported to our laboratory for geotechnical laboratory testing. Selected samples were visually classified and tested in our laboratory to evaluate their engineering properties as a basis for providing geotechnical recommendations for design and construction considerations. Laboratory testing included natural moisture contents (ASTM D 2216), Atterberg limits (ASTM D 4318 Method B), percent of particles finer than the No. 200 sieve (ASTM D 1140), and unconsolidated-undrained triaxial compression tests (ASTM D 2850).

Brief descriptions of laboratory test procedures used are presented on Figure B-1, Methods of Laboratory Testing, in Appendix B. Individual test results are presented either on the boring logs or on summaries of laboratory results on Figures B-2 through B-4 in Appendix B.

7. GEOLOGY AND SUBSURFACE CONDITIONS

The geology and subsurface conditions at the site are described in the following sections.

7.1. Geologic Setting

The site is located in the West Gulf Coastal Plain Province of the Atlantic Plain physiographic region. This province extends from the southern tip of Texas along the Gulf Coast to the Mississippi Alluvial Plain to the east. This physiographic region is characterized as a gently sloping plain with gentle rolling hills.

According to the Geologic Atlas of Texas, Houston Sheet, (1982), the surficial geology of the site is described as Barrier Island Deposits, consisting of mostly sand, interfingering with clay and silt in the landward direction. The USDA Web Soil Survey describes the surficial soils at the site as Mustang fine sand. This soil type is generally non-plastic.

7.2. Subsurface Conditions

Our understanding of the subsurface conditions at the project site is based on the results of our field exploration, laboratory tests, and our experience.

7.2.1. Undocumented Fill Soils

Undocumented fill soils were observed in Boring B-1 from the ground surface to a depth of about 2 feet bgs. The fill materials consisted of silty sands (SM) with trace gravel.

7.2.2. Barrier-Island Deposits

Native Barrier-Island Deposits were observed beneath the fill materials in Boring B-1 and from the ground surface in the remaining borings. These soils generally consisted of silty sands (SM) to depths of about 16 to 17 feet bgs in Borings B-1 and B-4 and to the boring termination depth of about 20 feet in Borings B-2 and B-3. Primarily fat clays (CH) were encountered underlying the sands in Borings B-1 and B-4 to the termination depths (about 45 and 20 feet, respectively). A stratum of silt with sand (ML) was encountered from about 32 to 37 feet bgs in Boring B-1.

More detailed stratigraphic information is presented on the boring logs in Appendix A. The boring logs contain our field and laboratory test results, as well as our interpretation of

conditions believed to exist between actual samples retrieved. Therefore, the boring logs contain both factual and interpretive information. Lines delineating subsurface strata on the boring logs are intended to group soils having similar engineering properties and characteristics. They should be considered approximate as the actual transition between soil types (strata) may be gradual. A key to the soil symbols and terms used on the boring logs is provided in Appendix A.

7.3. Depth-to-Water

The borings were drilled using dry-auger techniques in an attempt to measure depth-to-water in the open boreholes. Free water was observed during drilling at depths of about 8 to 12 feet bgs. Delayed water level readings could not be made due to the presence of caving soils at depths of 4 to 6 feet bgs.

Fluctuations in groundwater may occur as a function of tides, seasonal moisture variation, temperature, and groundwater withdrawal. Future construction activities may alter the surface and subsurface drainage characteristics of this site. In addition, perched groundwater could be encountered at the site after periods of heavy precipitation. The contractor should be prepared for shallow groundwater conditions at the site.

8. SEISMIC DESIGN CONSIDERATIONS

Design of the proposed improvements should be performed in accordance with the requirements of the governing jurisdictions and applicable building codes. Table 1 presents the seismic design parameters for the site in accordance with the 2012 International Building Code (IBC) guidelines and adjusted maximum considered earthquake (MCE) spectral response acceleration parameters evaluated using the USGS ground motion calculator (web-based).

Table 1 – 2012 International Building Code Seismic Design Criteria

Site Coefficients and Spectral Response Acceleration Parameters	Values
Site Class	D
Site Coefficient, F_a	1.6

Table 1 – 2012 International Building Code Seismic Design Criteria

Site Coefficients and Spectral Response Acceleration Parameters	Values
Site Coefficient, F_v	2.4
Mapped Spectral Acceleration at 0.2-second Period, S_s	0.068g
Mapped Spectral Acceleration at 1.0-second Period, S_1	0.036g
Spectral Acceleration at 0.2-second Period Adjusted for Site Class, S_{MS}	0.108g
Spectral Acceleration at 1.0-second Period Adjusted for Site Class, S_{M1}	0.087g
Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	0.072g
Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	0.058g

9. POTENTIAL SEASONAL MOVEMENTS

The Potential Vertical Rise (PVR) at the site was calculated using the Texas Department of Transportation (TxDOT) Method for Determining Potential Vertical Rise (TEX-124-E), and engineering judgment and experience. The estimated ground movements due to swelling of the underlying soils were calculated to be less than 1-inch at this site.

10. GEOTECHNICAL CONSIDERATIONS

Based on the results of our subsurface evaluation, laboratory testing, and data analysis, the proposed construction is feasible from a geotechnical standpoint, provided the recommendations in this report are incorporated into the design and construction of the project. Geotechnical considerations include the following:

- Soil conditions that differ from what were encountered in our boring may be encountered during construction.
- The PVR is estimated to be less than 1-inch at the site.
- Free water was observed as shallow as 8 feet bgs. Shallow groundwater and perched water may be encountered by the Contractor during construction.
- Conventional earthmoving construction equipment may be used.

- Many of the on-site soils may be suitable for re-use as select, engineered fill. On-site soils which are not suitable for re-use as select, engineered fill may be used as general fill for utility trench backfill.

- Imported soils that exhibit a very low to low swell potential, have a plasticity index between 8 and 20, have a liquid limit of less than 40, and sands (imported or soils generated from on-site excavation activities) that fall into the category of SP, SP-SM, and SM in accordance with USCS, and are free of deleterious materials can generally be used as select, engineered fill.

11. RECOMMENDATIONS

The following sections present our geotechnical recommendations and were developed based on our understanding of the proposed construction, the observed subsurface conditions, and our experience. If the proposed construction is changed from that discussed herein or subsurface conditions other than those shown on the boring logs (Appendix A) are observed at the time of construction, Ninyo & Moore should be retained to conduct a review of the new information and evaluate the need for additional recommendations.

The following design criteria were developed assuming new foundations will be constructed at or near existing grade (within 2 feet). If finished floor elevation will vary from existing grade by more than 1-foot, Ninyo & Moore should be retained to perform a review of the new information in order to evaluate the need for additional recommendations.

11.1. Earthwork

The following sections present our earthwork recommendations for this project. In general, City of Galveston construction standards and specifications are expected to apply, unless otherwise noted.

11.1.1. Subgrade Improvement

As discussed above, the PVR of the soils beneath the planned treatment structures is estimated to be on the order of 1-inch or less. Such a magnitude of potential movement is generally considered acceptable for such structures. As such, additional soil improvement methods to reduce the magnitude further are not needed.

However, new fill placed to raise site grade within structural areas should consist of select, engineered fill. Fill materials having a plasticity index more than 20 placed within the structural areas will increase the potential for slab movements and should not be used.

11.1.2. Site Preparation

Prior to placing any fill, pavement, or flatwork, the following guidelines should be followed:

- Obstructions that extend below finish grade, if any, should be removed and the resulting holes filled with compacted soil. Root balls remaining after tree removal operations (if any) should be removed and the resulting voids filled with compacted engineered fill. The root balls should be removed as early as possible prior to construction to allow the ground to reach a new equilibrium for the moisture content.

- After stripping, clearing, grubbing, and root raking is performed and prior to placement of any fill soils, the exposed subgrade should be evaluated by proofrolling. Any soft or weak areas observed during the proofrolling process should be removed and replaced with well-compacted material as outlined in Section 11.1.8.

- Proofrolling should be accomplished using a pneumatic-tired roller, a loaded dump truck, or similar equipment weighing approximately 20 tons and observed by the Geotechnical Engineer-of-Record, or the Engineer's designated representative.

Due to the nature of the surficial soils, traffic of heavy equipment (including heavy compaction equipment) may create pumping and general deterioration of shallow soils. Therefore, some construction difficulties should be anticipated, especially during periods when these soils are saturated.

11.1.3. Excavations

Our evaluation of the excavation characteristics of the on-site materials is based on the results of our exploratory borings, site observations, and experience with similar materials. Due to the heterogeneous nature of the project area soils, and the relatively

wide spacing between our borings, soils different than those encountered in our borings should be anticipated during construction.

In our opinion, soils at this site may be excavated using conventional heavy-duty earthmoving or excavation equipment. Equipment and procedures should be used that do not cause significant disturbance to excavation bottoms. The bottoms of excavations should expose competent soils and should be dry and free of loose, soft, or disturbed soil. Any soft, wet, weak, or deleterious materials should be over-excavated to expose strong competent soils.

Shallow free water was observed at the borings performed for this study at depths as shallow as about 8 feet bgs. As such, the Contractor should anticipate groundwater being encountered during construction. This may result in difficulty achieving compaction of the soil, and may also result in subgrade pumping, etc., during earthwork activities. Wet or saturated soils at the excavation bases may soften under the action of light equipment and foot traffic. Drying or over-excavation of these materials may be appropriate prior to filling. If the subgrade becomes disturbed, it should be compacted before placing the backfill material.

The sides of excavations should be sloped back and/or shored using bracing, such as trench boxes. Based on the soil conditions at the site, we recommend that an OSHA "Type C" soil classification be used for planning purposes for excavations at the site to depths of 20 feet or less. This corresponds to temporary slopes of 1.5:1 (horizontal: vertical). Upon excavation, soil classifications should be evaluated in the field by the Contractor's geotechnical consultant in accordance with OSHA regulations.

Flatter slopes or bracing may be needed if excessive sloughing or raveling is observed. If material is stored or equipment is operated near an excavation, flatter slopes or stronger shoring should be used to resist the extra pressure due to superimposed loads.

Temporary excavations that encounter groundwater seepage or surface runoff may need shoring or dewatering. Sandbags or gravel may need to be placed along the base of the seepage zone. Excavations encountering seepage should be evaluated on a case-by-case basis. Dewatering is discussed in Section 11.1.4 below.

11.1.4. Bottom Stability and Dewatering

As previously discussed, free water was observed as shallow as about 8 feet below existing grade during our field exploration. As such, we anticipate excavations for the planned lift station may extend below the observed free water depth. In addition, saturated non-cohesive soils (i.e. sands and silts) may be encountered within the depth of excavations. The Contractor should be aware of potential for encountering groundwater during construction and that a dewatering operation may need to be implemented. The depth of groundwater and the need for dewatering should be evaluated by the Contractor prior to beginning any excavation.

The stability of the bottom of excavations is dependent on the excavation geometry, soil strength parameters of the bearing soils, and the presence of groundwater. The bottom of an excavation in cohesionless soils is susceptible to "blow out" conditions when groundwater is present. Instability and quick conditions can occur when excavations approach charged granular layers without dewatering. In addition, if a saturated sand layer is situated beneath a clay layer, seepage pressures within the clay layer at the bottom of an excavation will result in unstable ground conditions. These conditions may endanger workers and equipment.

We recommend groundwater levels be kept 5 feet or more below the bottom of excavations. In addition, we recommend the use of an independent back-up system whenever workers are in or nearby excavations needing dewatering.

Typically, the Contractor is responsible for designing, installing and maintaining the dewatering system. Dewatering systems should be designed, installed and monitored by qualified personnel familiar with dewatering soils in the Houston Area.

11.1.5. Pipe Bedding and Trench Backfill

Pipe bedding and trench backfill materials should meet any requirements specified by City of Galveston standard specifications. Trench backfill as discussed herein refers to the material placed above the pipe zone/bedding backfill material. Based on the results of our study, many of the on-site soils are suitable for use as trench backfill.

Trench backfill material should be compacted as shown in Table 2 below. Lift thickness for backfill will be dependent upon the type of compaction equipment used, but should generally be placed in lifts not exceeding 8 inches in loose thickness. Special care should be exercised to avoid damaging the pipe or other structures during the compaction of the backfill.

11.1.6. Fill Materials

Imported soils that exhibit relatively low plasticity indices and very low to low expansive potential are generally suitable for re-use as select, engineered fill. Relatively low plasticity indices are defined as a PI value of 20, or less, as evaluated by ASTM D 4318. For this project select, engineered fill should have a liquid limit (LL) less than 40 and a PI between 8 and 20. On-site sands or imported soils that classify into the category of SP, SP-SM, and SM in accordance with USCS may also be used as select, engineered fill. Sands that classify as SP should not exceed minus 200 sieve more than 5 percent. The minus 200 sieve requirement for SP-SM sands is between 5 percent and 12 percent. The minus 200 sieve requirement for SM (silty sands) is between 12 and 49 percent.

In addition, suitable fill should not include organic material, construction debris, or other non-soil fill materials. Clay lumps and rock particles should not be larger than 6 inches in dimension. This material should be disposed of off-site or in non-structural areas.

Fill materials in contact with ferrous metals should also have low corrosion potential (minimum resistivity more than 2,000 ohm-cm, chloride content less than 25 parts per

million [ppm]). Fill material in contact with concrete should have a soluble sulfate content of less than 0.1 percent. The Geotechnical Engineer-of-Record should evaluate such materials and details of their placement prior to importation.

11.1.7. Re-use of Excavated Materials

Based on laboratory test results and our general observations, we anticipate that some of on-site soils may be suitable for re-use as select, engineered fill during construction. However, further testing should be performed during construction to evaluate that these soils comply with the percent minus 200 sieve specified in Section 11.1.6 to be re-used as select, engineered fill. Materials not suitable as select, engineered fill may be re-used as general fill and trench backfill at the site provided they are free of deleterious materials.

11.1.8. Fill Placement and Compaction

Fill soils, as well as scarified subgrade soils, should be moisture conditioned within the moisture range shown below in Table 2 and mechanically compacted to the percent compaction shown. Fill should generally be placed in 8-inch-thick loose lifts such that each lift is firm and non-yielding under the weight of construction equipment. Suitable fill soils should not contain organic material, construction debris, or other non-soil materials.

Table 2 – Summary of Compaction Recommendations

Description	Percent Compaction[1]	Moisture Content[2]
Select, Engineered Fill[3]	95 or more	-2% to +2%
General Fill – Sand	95 or more	-2% to +2%
General Fill – Clay[4]	95 or more	-1% to +3%
Lime-Fly Ash or Cement Treated Subgrade	95 or more	-1% to +3%

Notes:
[1]Percent compaction is the ratio of in-situ density and the maximum dry density by ASTM D 698.
[2]The range shown refers to the optimum moisture content by ASTM D 698.
[3]Select, engineered fill should meet the plasticity index between 8 and 20 and a liquid limit of 40 or less. Sands should meet the minus 200 sieve requirement as discussed in Section 11.1.6.
[4]Clayey soils used as fill should be processed so that particles or clods are no more than 6 inches in diameter prior to compaction.

11.1.9. Site Drainage

Adequate drainage should be provided to reduce seasonal variations in the moisture content of foundation soils. Pavement and sidewalks within 5 feet of the treatment structures should be sloped away from the structures to reduce the potential for water ponding near the foundations. Finished grade within 5 feet of the structures should be adjusted to slope away from the structures at a slope of 2 percent, or more. The long-term performance of the foundation system depends, in part, on maintaining positive surface drainage over the life of the structures.

11.2. Foundations

The planned treatment structures may be supported on shallow footings or mat foundations. Such foundation types, bearing in native soil or compacted select engineered fill, are appropriate for this site, provided the subgrade is prepared as described in the Earthwork section of this report.

Shallow mat foundations or spread, strip, and/or combined footings bearing on compacted select, engineered fill or native soil at a depth of 2 feet or more below exterior grade (as measured adjacent to the structure) may be designed using an allowable bearing pressure of 2,000 pounds per square foot (psf). This bearing pressure is based on a factor of safety of 3. This value may be increased by a factor of 1/3 for transient loads, such as wind and seismic. Continuous (strip) footings should have a width of 18 inches or more and isolated spread footings should have a width of 24 inches or more.

Foundation elements should be reinforced in accordance with the Structural Engineer's recommendations. Foundation excavations should be protected against any significant change in soil moisture content and disturbance by construction activity.

We estimate foundation movements of 1-inch or less may occur. Differential movements should not exceed half the predicted movement. Careful field observations of foundation excavations performed by the construction testing laboratory will contribute substantially to reducing foundation movements.

These settlement estimates are based on the assumption that the foundations act as isolated foundations, that is, the clear spacing between the foundation elements are the width or diameter of the largest adjacent foundation or more.

The Geotechnical Engineer-of-Record or his representative should monitor foundation excavations to locate any pockets or seams of unsuitable materials (organic material, wet, soft, or loose soil), which might be encountered in excavations for footings. Unsuitable materials encountered at the foundation bearing level should be removed and replaced with select fill as described in Section 11.1.8, or lean concrete (about 1,000 psi strength at 28 days).

The ultimate resistance of spread or strip footings to uplift forces is limited to the weight of the foundation plus the weight of any soil above the foundation. We recommend submerged unit weights of about 60 pounds per cubic foot (pcf) for soil and 90 pcf for concrete be used in calculations. The ultimate uplift resistance should be reduced by a factor of safety of 1.2 to calculate the allowable uplift capacity.

Lateral loads transmitted to footings will be resisted by soil-concrete friction on the base of the footings or stiffening beams. Frictional resistance may be estimated using an allowable coefficient of friction of 0.35, assuming a factor of safety of 1.5. The foundations should preferably be proportioned such that the resultant forces from the loads, including lateral loads, fall within the middle one-third of the footing base.

11.2.1. Foundation Construction Considerations

The Geotechnical Engineer-of-Record or his representative should monitor foundation excavations to locate any pockets or seams of unsuitable materials (organic material, wet, soft, or loose soil), which might be encountered in excavations for footings or shallow mats. Unsuitable materials encountered at the foundation bearing level should be removed and replaced with select fill as described in Section 11.1.8 or lean concrete (about 1,000 psi strength at 28 days).

The bottom 6 inches of foundation excavations should be performed using a smooth excavator bucket or by hand labor. Sides of excavations may slough to some extent with time. Sloughed soils and other debris in the bottom of the excavation should be removed prior to steel placement. Water should not be allowed to accumulate at the bottom of footing excavations.

Steel should be placed and concrete poured the day of excavation. If for some reason the foundations cannot be poured the day of excavation, a seal slab should be placed to protect the exposed foundation soils.

11.3. Lift Station Recommendations

A lift station is planned to be constructed near Boring B-1. We understand the lift station is planned to have a bottom (or foundation) elevation of about 25 feet below existing grade. Excavation to this depth may encounter groundwater and saturated sandy soils.

We understand the lift station is planned to be constructed by the caisson sinking method. The caisson should be designed and constructed in accordance with City of Galveston Standard Specification Section 02380 “Caisson for Lift Station.” The caisson should be designed as a friction unit using an allowable side shear resistance of 200 psf for the portion of the shaft extending below a depth of 4 feet to 14 feet and 400 psf from 14 to 25 feet. This side shear resistance is based on a factor of safety of 2.

An allowable net bearing pressure of 3,000 psf (assuming a factor of safety of 2) may be used for the design of the proposed lift station bearing on undisturbed native soil at a depth of 25 feet below the ground surface.

The below-grade structure should be designed for lateral earth pressures against the walls. Equivalent fluid density values for computation of lateral soil pressures acting on the exterior walls of the underground retaining structure were evaluated for the on-site native soils. An equivalent fluid pressure of 115 pcf may be used. Surcharge loading (q) on the lift station may be taken as 0.5q.

Free water at the site was measured as shallow as about 8 feet below the ground surface. Mitigation of groundwater may be needed during the construction of the lift station. Dewatering is discussed in Section 11.1.4 above.

Buoyant uplift pressure will act on the structure located below the water table. Buoyant uplift pressure is a function of the depth of the structure below groundwater. The largest uplift pressure will occur when the groundwater is at the ground surface. We recommend that the buoyant uplift pressure be resisted by the dead weight of the structure and the weight of any soil backfilled above the structure. In addition, an allowable uplift friction value of 100 psf may be used along the walls of the lift station between a depth of 4 feet and 14 feet bgs and 250 psf between 14 and 25 feet bgs. This allowable friction is based on a factor of safety of 3. If the uplift resistance as described above is not sufficient to resist uplift pressure, a horizontal projection slab at the foundation base could be constructed to increase the dead load to resist uplift pressure. We recommend using a buoyant unit weight of 90 pcf for the concrete and 60 pcf for the soil to compute uplift resistance.

Typically, installing lift station using the caisson method will create an annulus space around the perimeter of the caisson. We recommend that the annulus space be grouted to fully mobilize the above recommend skin friction values for the uplift capacities.

11.4. Concrete

We recommend the use of Type II cement for construction of concrete structures at this site. Due to potential uncertainties as to the use of reclaimed irrigation water, or topsoil that may contain higher sulfate contents, pozzolan or admixtures designed to increase sulfate resistance may be considered.

Laboratory chemical tests were not performed to evaluate the sulfate content of the site soils for this project. We assume that the soluble sulfate content at the project site less than 0.2 percent by weight. If desired, laboratory chemical testing can be performed to estimate the sulfate content of the onsite soils.

Concrete should have a water-cement ratio of no more than 0.50 by weight for normal weight aggregate concrete. The Structural Engineer should ultimately select the concrete design strength and the water-cement ratio based on the project specific loading conditions. Higher strength concrete may be selected for increased durability and resistance to slab curling and shrinkage cracking.

In order to reduce the potential for shrinkage cracks in the concrete during curing, we recommend that for slabs-on-grade, the concrete be placed with a slump in accordance with Table 5.2.1 of Section 302.1R of "Guidelines for Floor and Slab Construction". If a higher slump is needed for screening and leveling, a super plasticizer is recommended to achieve the higher slump without changing the recommended water to cement ratio. The slump should be checked periodically at the site prior to concrete placement. We also recommend that crack control joints be provided in slabs in accordance with the recommendations of the Structural Engineer to reduce the potential for distress due to minor soil movement and concrete shrinkage. We further recommend that concrete cover over reinforcing steel for slabs-on-grade and foundations are in accordance with IBC 1907.7.1. The Structural Engineer should be consulted for additional concrete specifications.

11.5. Pre-Construction Conference

We recommend a pre-construction conference be held. Representatives of the Owner, Civil engineer, the Geotechnical Consultant, and the Contractor should be in attendance to discuss the project plans and schedule. Our office should be notified if the project description included herein is incorrect, or if the project characteristics are significantly changed.

11.6. Construction Observation and Testing

During construction operations, we recommend a qualified geotechnical consultant perform observation and testing services for the project. These services should be performed to evaluate exposed subgrade conditions, including the extent and depth of over-excavation, to evaluate the suitability of proposed borrow materials for use as fill and to observe placement and test compaction of fill soils. If another geotechnical consultant is selected to perform

observation and testing services for the project, we request that the selected consultant provide a letter to the owner, with a copy to Ninyo & Moore, indicating that they fully understand our recommendations and they are in full agreement with the recommendations contained in this report. Qualified subcontractors utilizing appropriate techniques and construction materials should perform construction of the proposed improvements.

12. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of mankind at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the Client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the Client is undertaken at said parties' sole risk.

13. REFERENCES

American Concrete Institute, 1991a, Guidelines for Concrete Floor and Slab Construction (ACI 302.1R).

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Source: US Geological Survey 7.5-minute topographic map, Galveston, Texas, 2016.

N

0 3300

Approximate Scale:
1 inch = 3300 feet

Note: Dimensions, directions and locations are approximate.

Ninyo & Moore		**SITE LOCATION**	FIGURE 1
PROJECT NO:	DATE:	PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS MOYENNE PLACE NEAR LAFITTES POINT GALVESTON, TEXAS	
700660001	6/17		

bsm file no: 0660vmap0517



Source: NAVTEQ, 11/21/15.

N

0 140

Approximate Scale:
1 inch = 140 feet

Note: Dimensions, directions and locations are approximate.

bsm file no: 0660blm0517

Ninyo & Moore		BORING LOCATIONS	FIGURE
PROJECT NO:	DATE:	PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS MOYENNE PLACE NEAR LAFITTES POINT GALVESTON, TEXAS	2
700660001	6/17		

APPENDIX A

EXPLANATION OF FIELD SAMPLING PROCEDURES

Field Procedure for the Collection of Relatively Undisturbed Samples

Relatively undisturbed soil samples were obtained in the field using the following method.

Shelby Tube

The Shelby tube is a seamless, thin-walled, steel tube having an external diameter of 3 inches and a length of 30 inches. The tube was connected to the drill rod or a hand tool and pushed into an undisturbed soil mass to obtain a relatively undisturbed sample of soft, cohesive soil in general accordance with ASTM D 1587. When the tube was almost full (to avoid over-penetration), it was withdrawn from the boring. The samples were removed from the sampling tubes in the field, assessed visually, and evaluated for consistency. A selected portion of each sample was then wrapped in aluminum foil and sealed in a plastic bag for use in future visual assessment and possible testing in our laboratory.

Field Procedure for the Collection of Disturbed Samples

Disturbed soil samples were obtained in the field using the following methods.

The Standard Penetration Test (SPT) Sampler

Disturbed samples of earth materials were obtained by means of a split spoon sampler during Standard Penetration Testing. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of $1^{3}/_{8}$ inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were removed from the sampler, visually classified, bagged, sealed and transported to the laboratory for testing.

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

[A]Based on the material passing the 3-in. (75-mm) sieve

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

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

[D]$Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2 / (D_{10} \times D_{60})$

[E]If soil contains ≥ 15% sand, add "with sand" to group name.

[F]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[G]If fines are organic, add "with organic fines" to group name.

[H]Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[I]If soil contains ≥ 15% gravel, add "with gravel" to group name.

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

[K]If soil contains 15 to <30% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L]If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

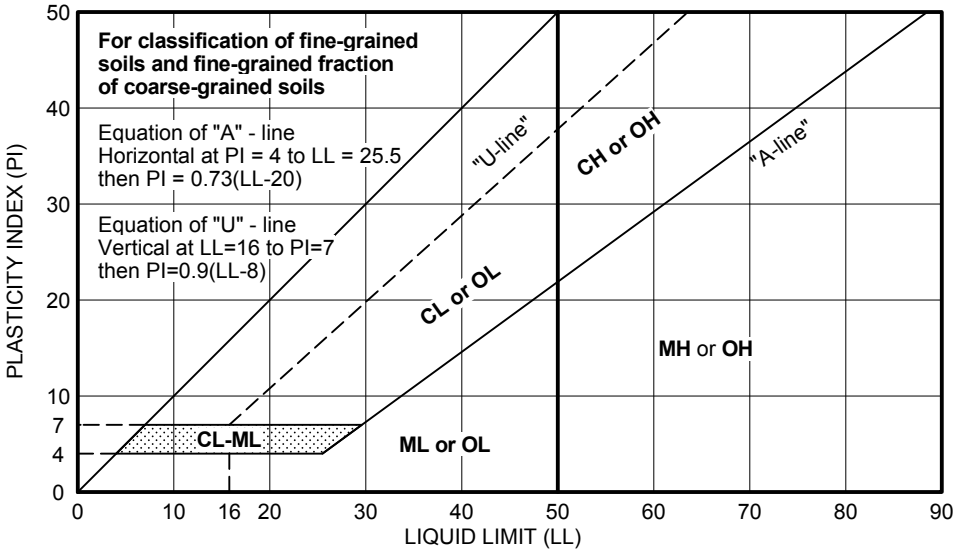
[M]If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N]PI ≥ 4 and plots on or above "A" line.

[O]PI < 4 or plots below "A" line.

[P]PI plots on or above "A" line.

[Q]PI plots below "A" line.

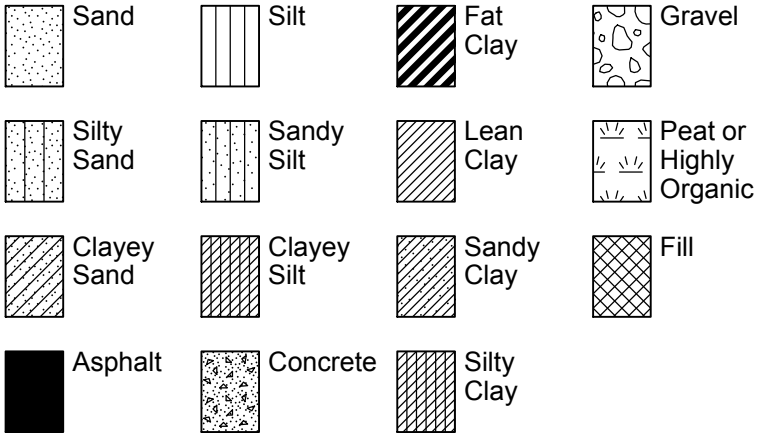


BASED ON TABLE 1 "SOIL CLASSIFICATION CHART" ASTM D 2487-11

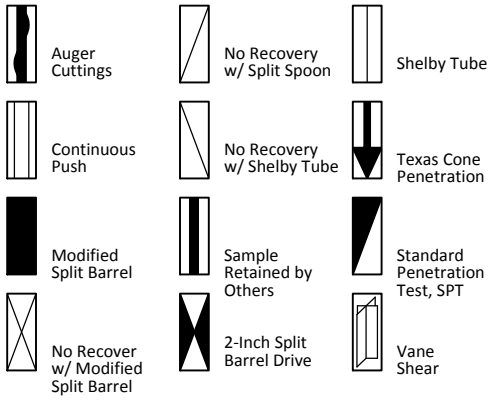
Ninyo & Moore	SOIL CLASSIFICATION CHART	FIGURE A-2
PROJECT NO: 700660001 / DATE: 6/17	PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS MOYENNE PLACE NEAR LAFITTES POINT GALVESTON, TEXAS	

SYMBOLS

SOIL TYPES



SAMPLER TYPES



TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using available invormation from the field and laboratory studies. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-11 and D2488-09a, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2015.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Lines delineating subsurface strata on the boring logs are intended to group soils having similar engineering properties and characteristics. They should be considered approximate as the actual transition between soil types (strata) may be gradual.

RELATIVE DENSITY

Penetration Resistance Blows per ft	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
> 50	Very Dense

COHESIVE STRENGTH

Resistance Blows per ft	Consistency	Cohesion ksf
0 - 2	Very Soft	0 - 0.25
3 - 4	Soft	0.25 - 0.5
5 - 8	Firm	0.5 - 1.0
9 - 15	Stiff	1.0 - 2.0
16 - 30	Very Stiff	2.0 - 4.0
> 30	Hard	> 4.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0 - 5	None
6 - 10	Low
11 - 20	Moderate
21 - 40	Plastic
> 40	Highly Plastic

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

Ninyo & Moore		**TERMS AND SYMBOLS USED ON BORING LOGS**	FIGURE A-3
PROJECT NO: 700660001	DATE: 6/17	PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS MOYENNE PLACE NEAR LAFITTES POINT GALVESTON, TEXAS	

DATE DRILLED 4/24/2017 BORING NO. B-1

GROUND ELEVATION Not Provided SHEET 1 OF 2

METHOD OF DRILLING Straight Flight Auger & Mud Rotary

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY REG LOGGED BY REG REVIEWED BY SJ

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR, ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
0						13				17				SM	FILL: Brown, moist, silty SAND, with trace gravel and rootlets.
				26		24								SM	BARRIER ISLAND DEPOSITS: Bluish gray, moist, medium dense, silty SAND; rootlets; clay pockets.
				11		20									Hydrocarbon odor, 4 to 8 feet; clay pockets; trace shell and organics, 4 to 10 feet.
				9		19									Loose; trace gravel.
10	▽			10		26				15					
				29		26				18					Medium dense.
														CH	Brown and tan, moist, stiff, fat CLAY; calcareous concretions, 18 to 25 feet; slickensided.
					103	24	53	18	35	88	1.4		1.5		
20															
					109	20					1.8		1.75		
						22	53	20	33				1.25		Trace shells.

GROUND WATER OBSERVATIONS

▽ First Observed (ft): 10

▼ After Drilling (ft): N/A

▼ After ____ Hours (ft): ____

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	6/17	A-4a

DATE DRILLED 4/24/2017 BORING NO. B-1
GROUND ELEVATION Not Provided SHEET 2 OF 2
METHOD OF DRILLING Straight Flight Auger & Mud Rotary
DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches
SAMPLED BY REG LOGGED BY REG REVIEWED BY SJ

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR, ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
															Brown and tan, moist, stiff, fat CLAY; calcareous concretions, 18 to 25 feet; slickensided. *(continued)*
				20		23				79				ML	Brown, moist, medium dense, SILT with sand.
				25		37	77	30	47					CH	Brown, moist, very stiff, fat CLAY; silt seams.
40													3.0		Calcareous nodules.
															Total Depth = 45 feet. Free water was first observed during dry drilling operations at 10 feet. Delayed water level measurement was not possible due to caving soils at 6 feet. Mud rotary drilling methods were used below 10 feet. Boring was backfilled with soil cuttings after completion on 4/24/2017. Note: Groundwater may rise to a higher level than that measured in our boring due to seasonal varia-tions in precipitation and several other factors discussed in the report.
50															

GROUND WATER OBSERVATIONS
▽ First Observed (ft): 10
▼ After Drilling (ft): N/A
▼ After ____ Hours (ft): ____

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	6/17	A-4b

DATE DRILLED 4/24/2017 BORING NO. B-2

GROUND ELEVATION Not Provided SHEET 1 OF 1

METHOD OF DRILLING Straight Flight Auger & Mud Rotary

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY REG LOGGED BY REG REVIEWED BY SJ

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR, ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
0						13								SM	BARRIER ISLAND DEPOSITS: Brown, moist, silty SAND; rootlets to 6 feet.
				26		19				15					Medium dense; trace gravel, 2 to 6 feet.
				25		16									
	▽			14		23				17					Gray; clay pockets; trace shell, 6 to 10 feet.
				31		23									Light brown; dense.
10															
				26											Medium dense.
				23											Trace shells; clay pockets.
20															Total Depth = 20 feet. Free water was first observed during dry drilling operations at 8 feet. Delayed water level measurement was not possible due to caving soils at 4 feet. Mud rotary drilling methods were used below 8 feet. Boring was backfilled with soil cuttings after completion on 4/24/2017. Note: Groundwater may rise to a higher level than that measured in our boring due to seasonal varia-tions in precipitation and several other factors discussed in the report.

GROUND WATER OBSERVATIONS

▽ First Observed (ft): 8

▼ After Drilling (ft): N/A

▼ After ____ Hours (ft): _____

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	6/17	A-5

DATE DRILLED 4/24/2017 BORING NO. B-3

GROUND ELEVATION Not Provided SHEET 1 OF 1

METHOD OF DRILLING Straight Flight Auger & Mud Rotary

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY REG LOGGED BY REG REVIEWED BY SJ

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR, ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
0						13				13				SM	BARRIER ISLAND DEPOSITS Brown, moist, silty SAND; rootlets to 6 feet.
				9		22									Brown and tan; loose; clay pockets.
				8		22			NP	25					Brown and gray; loose.
				17		22									Gray; medium dense; clay pockets; trace shell, 6 to 10 feet.
				14		24									
10	▽														
				22											
				15											
20															Total Depth = 20 feet. Free water was first observed during dry drilling operations at 12 feet. Delayed water level measurement was not possible due to caving soils at 6 feet. Mud rotary drilling methods were used below 12 feet. Boring was backfilled with soil cuttings after completion on 4/24/2017. Note: Groundwater may rise to a higher level than that measured in our boring due to seasonal varia-tions in precipitation and several other factors discussed in the report.

GROUND WATER OBSERVATIONS

▽ First Observed (ft): 12

▼ After Drilling (ft): N/A

▽ After ____ Hours (ft): _____

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	6/17	A-6

DATE DRILLED 4/24/2017 BORING NO. B-4

GROUND ELEVATION Not Provided SHEET 1 OF 1

METHOD OF DRILLING Straight Flight Auger & Mud Rotary

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY REG LOGGED BY REG REVIEWED BY SJ

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR, ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
0				39		14								SM	BARRIER ISLAND DEPOSITS: Brown, moist, medium dense, silty SAND; clay pockets; trace gravel.
				73		17				31					Bluish gray; very dense.
				57		21									
	▽			17		23				21					Medium dense; clay pockets, 6 to 10 feet.
				13		25									Bluish gray and tan; trace gravel.
10				15											
						20	57	23	34				1.25	CH	Gray and tan, moist, stiff, fat CLAY; calcareous concretions.
20															Total Depth = 20 feet. Free water was first observed during dry drilling operations at 8 feet. Delayed water level measurement was not possible due to caving soils at 6 feet. Mud rotary drilling methods were used below 8 feet. Boring was backfilled with soil cuttings after completion on 4/24/2017. Note: Groundwater may rise to a higher level than that measured in our boring due to seasonal varia-tions in precipitation and several other factors discussed in the report.

GROUND WATER OBSERVATIONS

▽ First Observed (ft): 8

▼ After Drilling (ft): N/A

▼ After ____ Hours (ft): ____

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	6/17	A-7

APPENDIX B

METHODS OF LABORATORY TESTING

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classifications System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the Boring Log in Appendix A and in the following summary tables in Appendix B.

Moisture Content

The moisture content of samples obtained from the exploratory boring was evaluated in accordance with ASTM D 2216. The test results are presented on the Boring Log in Appendix A and in the Summary of Laboratory Results, Figure B-3.

No. 200 Wash

An evaluation of the percentage of particles finer than the No. 200 sieve in selected soil samples was performed in general accordance with ASTM D 1140. The results of the tests are presented on Figure B-2, on the Boring Log in Appendix A, and in the Summary of Laboratory Results, Figure B-3.

SAMPLE LOCATION	DEPTH	DESCRIPTION	PERCENT PASSING NO. 4	PERCENT PASSING NO. 200	USCS
B-1	0 - 2	Silty SAND	100.0	16.7	SM
B-1	8.5 - 10	Silty SAND	100.0	15.3	SM
B-1	13.5 - 15	Silty SAND	100.0	18.3	SM
B-1	18 - 20	Fat CLAY	100.0	87.5	CH
B-1	33.5 - 35	SILT w/ Sand	100.0	79.1	ML
B-2	2.5 - 4	Silty SAND	100.0	14.6	SM
B-2	6.5 - 8	Silty SAND	100.0	17.4	SM
B-3	0 - 2	Silty SAND	100.0	13.4	SM
B-3	4.5 - 6	Silty SAND	100.0	24.7	SM
B-4	2.5 - 4	Silty SAND	100.0	31.4	SM
B-4	6.5 - 8	Silty SAND	100.0	21.4	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D1140.

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NO. 200 WASH

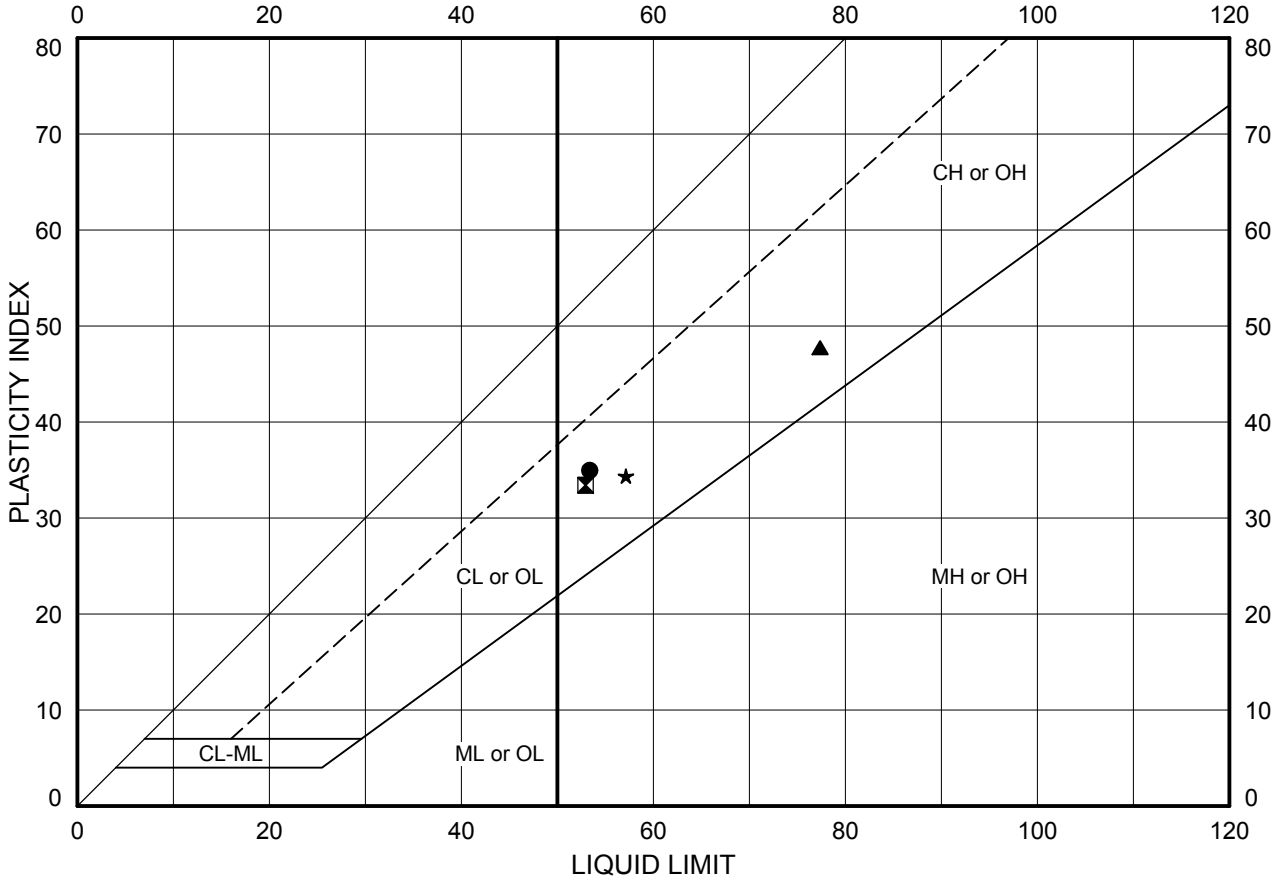
FIGURE
B-2

PROJECT NO: 700660001

DATE: 6/17

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

Symbol	Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	USCS (Fraction Finer Than No. 40 Sieve)	USCS (Total Sample)
●	B-1	18 - 20	53	18	35	CH	CH
⊠	B-1	28 - 30	53	20	33	CH	CH
▲	B-1	38.5 - 40	77	30	47	CH	CH
★	B-4	18 - 20	57	23	34	CH	CH
⊙							
✿							
○							
△							
⊗							
⊕							



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D4318.

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ATTERBERG LIMITS

FIGURE
B-3

PROJECT NO: 700660001

DATE: 6/17

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Shear Strength (ksf)	%<#200 Sieve	USCS Group Symbol	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-1	0 - 2					17	SM	13.0			
B-1	2.5 - 4						SM	24.0			
B-1	4.5 - 6						SM	20.0			
B-1	6.5 - 8						SM	19.0			
B-1	8.5 - 10					15	SM	26.0			
B-1	13.5 - 15					18	SM	26.0			
B-1	18 - 20	53	18	35	1.4[Q]	88	CH	24.0	103.3		
B-1	23 - 25				1.8[Q]		CH	20.0	108.7		
B-1	28 - 30	53	20	33	1.25[P]		CH	22.0			
B-1	33.5 - 35					79	ML	23.0			
B-1	38.5 - 40	77	30	47			CH	37.0			
B-1	43 - 45				3.0[P]		CH				
B-2	0 - 2						SM	13.0			
B-2	2.5 - 4					15	SM	19.0			
B-2	4.5 - 6						SM	16.0			
B-2	6.5 - 8					17	SM	23.0			
B-2	8.5 - 10						SM	23.0			
B-3	0 - 2					13	SM	13.0			
B-3	2.5 - 4						SM	22.0			
B-3	4.5 - 6	NP	NP	NP		25	SM	22.0			
B-3	6.5 - 8						SM	22.0			
B-3	8.5 - 10						SM	24.0			
B-4	0 - 2						SM	14.0			
B-4	2.5 - 4					31	SM	17.0			
B-4	4.5 - 6						SM	21.0			
B-4	6.5 - 8					21	SM	23.0			
B-4	8.5 - 10						SM	25.0			
B-4	18 - 20	57	23	34	1.25[P]		CH	20.0			

*Void ratio based on assumed specific gravity of 2.70.

U = Unconfined Compr; Q = Q-Type; T = Torvane; P = Pocket Pen

Ninyo & Moore

SUMMARY OF LABORATORY RESULTS

FIGURE B-4

PROJECT NO: 700660001

DATE: 6/17

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

May 8, 2020
Project No. 700660001

Mr. William Schlafer, PE, PMP
Lockwood Andrews & Newnam, Inc.
2925 Briarpark Drive, Suite 400
Houston, Texas 77042

Subject: Supplemental Geotechnical Evaluation
Pirates Beach Wastewater Treatment Plant Improvements
Moyenne Place Near Lafittes Point
Galveston, Texas

Dear Mr. Schlafer:

As you know, we previously performed a geotechnical evaluation for this project and presented our findings and recommendations in our report titled "Geotechnical Evaluation, Pirates Beach Wastewater Treatment Plant Improvements, Moyenne Place Near Lafittes Point, Galveston, Texas," dated June 1, 2017. This letter provides supplemental recommendations for the planned structures at the Pirates Beach Wastewater Treatment Plant (WWTP) site. This addendum letter is intended to supplement the information in our original report and should not be used separately from our original report.

PROPOSED CONSTRUCTION

Details of the planned treatment structures were not available at the time of our original evaluation. Based on the 60 percent design submittal by LAN (dated February 19, 2019) and other correspondence, we understand planned construction at the WWTP will include a headworks structure with two drum screens, two clarifiers with surrounding aeration basins, a blower/MCC building, RAS/WAS pumps, and a disk filter/UV disinfection system. We understand finished grade will generally match existing, with the exception of an approximately 5- to 8-foot-high berm to be placed to the north and east of the main treatment structures.

The proposed headworks will consist of two elevated platforms and at grade equipment. The drum screens and associated equipment will be mounted to an approximate 30- by 36-foot elevated platform at approximately 18 feet above finished grade. The grit removal unit will be mounted to an elevated platform about 15 feet above grade. Both platforms will be supported by columns and

founded on drilled shafts or auger cast-in-place (ACIP) piles. The roll-off dumpster and grit classifier will be founded on grade-supported mat slabs.

The proposed aeration basins will consist of two 24-foot high, 48- by 48-foot basins with a 30-foot diameter clarifier in the center of each basin. The aeration basin and clarifiers will have cast-in-place concrete walls and will be supported on a cast-in-place mat foundation. We understand the mat foundation will have a thickness of about 2 feet, bear about 4 to 5 feet below existing grade, and apply a pressure on the order of 4,500 pounds per square foot (psf) to the subgrade soils. A mix box and sludge holding tank will be adjacent to the north wall of the aeration basin. The RAS/WAS pumps will be founded on grade-supported mat slabs.

The proposed MCC/Blower Building will be a precast concrete building on an elevated cast-in-place concrete platform adjacent to the aeration basin. The proposed UV and filter system will be on an elevated platform at approximately 18 feet above finished grade. The platforms will be supported by columns and founded on drilled shafts or ACIP piles.

Based on correspondence with LAN, we understand the drilled shafts/ACIP piles will have two shaft-head cases: free-head and fixed-head. For the free-head piers, the concrete columns will be an extension of the drilled shaft/ACIP pile and may or may not use a pile cap. For the fixed-head piers, the columns will terminate into pier caps and the pier caps will be connected with tie beams. The maximum anticipated loads for the free-head condition are on the order of 120 kips axial load, 8 kips lateral load, and a moment of 110 kip-feet. For the fixed-head condition, the maximum anticipated loads are on the order of 150 kips axial load and 8 kips lateral load.

SUPPLEMENTAL FIELD EXPLORATION AND LABORATORY TESTING

On April 15, 2020, Ninyo & Moore a performed supplemental subsurface exploration at the site in order to evaluate subsurface conditions at depths greater than those explored in our previous borings. Our fieldwork consisted of drilling, logging, and sampling an additional exploratory soil boring, designated B-5 (Figure 2), to a depth of about 70 feet below the ground surface (bgs) using an ATV-mounted drill rig equipped with straight-flight augers and rotary wash equipment. In addition, we supplemented Boring B-1 from our previous report with a boring at the headworks area, designated B-1A. Boring B-1A was drilled without sampling to a depth of about 43 feet bgs and then sampled at regular intervals to about 70 feet bgs. The drilling and sampling procedures were consistent with those described in our original report. The boring excavations were backfilled with soil cuttings on conclusion of our fieldwork. Descriptions of the soils encountered in our borings are presented on boring logs in Appendix A.

Supplemental laboratory testing included natural moisture contents (ASTM D2216), Atterberg limits (ASTM D4318 Method B), percent of particles finer than the No. 200 sieve (ASTM D1140), and unconsolidated-undrained triaxial compression tests (ASTM D2850). The test procedures were consistent with those described in our original report. The test results are presented on the Boring Logs and in Appendix B.

RECOMMENDATIONS

Deep Foundations (Straight-Sided Drilled Shafts and ACIP Piles)

The proposed headworks, MCC/Blower Building, and UV and filter system may be supported using straight-sided drilled shafts or ACIP piles. We recommend drilled shafts have a diameter of 24 inches or more. ACIP piles typically have diameters of 18 or 24 inches. Based on correspondence with LAN, we understand the maximum anticipated axial loads are on the order of 150 kips.

Straight-sided drilled shafts or ACIP Piles for this project may be designed as friction units proportioned using the allowable unit skin friction values in compression presented below in Table 1. We recommend the Structural Engineer neglect the capacity of clays within the upper 8 feet due to seasonal moisture change and construction disturbance. End bearing should also be neglected.

Table 1 – Allowable Skin Friction Values

Depth (feet)	Allowable Skin Friction (psf)	
	Drilled Shafts	ACIP
0 to 8	0	0
8 to 15	400	400
15 to 30	350	425
30 to 50	550	700
50 to 60	700	700
60 to 70	300	350

Allowable Uplift Resistance

Resistance to uplift forces exerted on straight-sided drilled shafts or ACIP piles will be provided by the dead load of the shaft/pile plus the allowable skin resistance provided by the soil. A buoyant unit weight of 90 pcf should be used for the dead load of the shaft/pile concrete. The resistance provided by the soil depends on the shear strength of the soils adjacent to the shaft/pile. The allowable uplift resistance provided by the soils at this site may be calculated

using 2/3 of the allowable axial compressive side shear resistance as provided above. We recommend that the Structural Engineer neglect the side friction resistance of the upper 8 feet due to construction disturbance. Reinforcing steel will be needed in each shaft/pile according to the recommendations of the Structural Engineer.

Lateral Load Resistance

As requested by LAN, the Project Structural Engineer, we performed an analysis of the lateral load resistance of single, isolated drilled shafts at this site using the software program LPile by Ensoft. The expected pile behavior under the applied loading conditions depends on subsurface conditions, loading conditions, the shaft diameter, and the engineering properties of the shaft materials. The input parameters we used to model soil behavior in the L-Pile analysis are provided below in Table 2. A depth to water of 8 feet was assumed.

Table 2 – L-Pile Input Parameters for Deep Foundations

Depth Below Ground Surface (feet)	p-y Curve Type	γ (pcf)	c (psf)	ϕ (°)	k_s (pci)	k_c (pci)	ε_{50}
0 to 8	Sand (Reese)	115	-	29	20	20	-
8 to 15	Sand (Reese)	55	-	30	60	60	-
15 to 30	Stiff Clay with Free Water (Reese)	60	1,250	-	500	200	0.007
30 to 50	Stiff Clay with Free Water (Reese)	60	2,000	-	500	200	0.007
50 to 60	Sand (Reese)	55		30	60	60	-
60 to 70	Stiff Clay with Free Water (Reese)	60	1,000	-	500	200	0.007

For our analysis, we have assumed the shafts will have a diameter of 24 inches and a length of 60 feet, and will be constructed using concrete with a compressive strength of 3,000 pounds per square inch (psi). We modeled the shaft reinforcing steel as consisting of a central, grade-150, threaded rod with a diameter of 1-inch and no perimeter reinforcement.

Using the soil parameters, shaft dimensions, and material properties, we performed L-Pile analyses for a single drilled shaft with a top-of-shaft depth of 5 feet, considering both fixed-head and free-head drilled shaft conditions. Lateral loads applied in 4 kip intervals from 4 to 16 kips were considered for each pier head condition. The results of our analyses are presented as deflection, moment, and shear diagrams along the length of the shaft in Figures 3 and 4 for the fixed-head and free-head conditions, respectively.

At the top of drilled shaft (5 feet below grade), deflections of about 0.02 and 0.46 inches were calculated for fixed-head and free-head conditions, respectively, for the design lateral load of 8 kips. The depths along the shaft at which the shear force and bending moment approach zero (the point of fixity) are approximately 26 and 28 feet below the top of the shaft for fixed-head and free-head conditions, respectively.

Group Effects

The overall allowable axial and lateral load carrying capacities of a group of drilled shafts/ACIP piles may, in some cases, be less than the sum of the individual allowable capacities. The reduction in individual capacity depends on many factors including the configuration of the group, number of shafts/piles in the group, the depth of installation, and the spacing.

We recommend that drilled shafts/ACIP piles should be spaced three shaft/pile diameters (center-to-center) or more to reduce substantial axial group effects. If shafts/piles are spaced closer than three diameters, Ninyo & Moore should be contacted to review the shaft/pile layout and evaluate the need for additional recommendations.

For lateral loads, the shaft/pile group arrangement and the center-to-center spacing between adjacent shafts/piles have a significant impact on lateral group effects. Leading row shafts/piles generally experience less reduction in lateral capacity as compared to trailing row shaft/piles for the same head deflection criteria. Shafts/piles spaced more than about six diameters, center-to-center, generally have limited group effects. We recommend using the P-multiplier (Pm) values provided below in Table 3 (from Table 14-2, FHWA-NHI-10-016, 2010) for the drilled shafts/ACIP piles in a group.

Table 3 – Lateral Load P-Multiplier by Row Position

Pile Spacing	3D	4D	5D	6D
Lead Row	0.7	0.85	1.0	1.0
2nd Row	0.5	0.65	0.85	1.0
3rd and Higher Rows	0.35	0.5	0.7	1.0

Settlement Considerations

A detailed settlement analysis for drilled shafts/ACIP piles was beyond the scope of this study. However, based on our experience, we expect settlements to be less than about 1-inch for individual, isolated shafts/piles designed and constructed in accordance with the recommendations presented herein. Differential settlements resulting from variations in subsurface conditions and loading conditions are expected to be less than ½-inch.

It should be noted that groups of shafts/piles will likely settle more than individual shafts/piles subjected to the same load per foundation. We can perform a detailed settlement analysis if requested.

Drilled Shaft Construction Considerations

As discussed in Section 7.3 of our original report, free water was observed in our borings at depths of about 8 to 12 feet bgs. As such, groundwater seepage should be anticipated during drilled shaft installation, particularly during or after periods of precipitation.

Submersible pumps, bailing tools, and/or immediate placement of concrete may be sufficient to mitigate light seepage. However, due to the presence of sandy soil strata at the site, sloughing of sandy soils into drilled shaft excavations should be expected, particularly in the presence of free groundwater. Temporary steel casing or slurry will likely be needed to reduce sloughing of soils during shaft drilling operations and to mitigate water seepage as encountered. We recommend a separate bid item be provided for casing and/or slurry on the contractors' bid schedule.

Steel casing should extend below the depth of the sloughing soils before excavation begins, and then be removed after placement of concrete. Casing should be seated in clay soils. Water and loosened material should then be removed from the cased excavation before starting the design penetration. As casing is extracted, care should be taken to maintain a positive head of plastic concrete and reduce the potential for intrusion of water seepage. The contractor should expect the concrete level to change as the casing is removed and be prepared to both clean out the top of the drilled shaft and top-off the shaft with wet concrete.

For slurry construction, a tremie pipe connected either to a hopper or concrete pump should be used to displace the slurry water in the drilled shaft excavation upwards as the concrete is placed. If this method is used, detailed procedures should be submitted by the contractor for review and approval by the geotechnical engineer.

Each drilled shaft excavation should be observed by a Ninyo & Moore representative who is familiar with the geotechnical aspects of the soil stratigraphy, the structural configuration, foundation design details and assumptions, prior to placing concrete. This is to observe that:

- The shaft has been excavated to the specified dimensions at the correct depth established by the previously mentioned criteria;
- Drilled shaft excavations are not left open overnight;

- The shaft has been drilled plumb within specified tolerances along its total length; and
- Excessive cuttings, buildup and soft, compressible materials have been removed from the excavation.

Auger Cast-in-Place Pile Installation Considerations

Proper installation of auger cast-in-place piles is dependent upon the Contractor's experience, construction procedures, and equipment. Installation factors have a greater effect on the performance of auger cast-in-place piles compared to any other type of deep foundation. Detailed pile installation specifications specifically addressing the special concerns of auger cast-in-place piles should be prepared as part of the construction package. The pile specifications should be in general accordance with the Auger Cast-in-Place Pile Model Specification (2016), prepared by the Deep Foundations Institute. Ninyo & Moore should review the proposed specifications prior to construction.

Contractor Experience and Equipment

Auger-cast piles represent a specialized foundation system and need a high level of expertise for proper installation. Consequently, we recommend that only contractors experienced with this type of foundation and subsurface conditions be considered for this project.

The selected Contractor should have relevant project experience with auguring and pumping equipment, installation of similar sized auger piles in similar subsurface soil conditions, placement of reinforcing steel, as well as experience handling the special grout mixes and admixtures. The Contractor's crane should generally be equipped with a torque converter to allow the auger to be withdrawn at a slow continuous rate without sudden jerking.

Our experience indicates that not every Contractor has the specialized equipment and experience needed to successfully install auger cast-in-place piles. As such, we strongly recommend that the Contractor's qualifications and experience records be reviewed as part of the selection process.

Grout Mix

The pile contractor should be able to demonstrate that a grout mix can be furnished to meet this project's requirements. The results of a test mix design or test results from a previous project should be specified to be submitted prior to approval of the grout mix for construction. During construction, the fluidity of the grout mix should be tested for

conformance with the project specifications. Compressive strength of the grout mix should be tested with cubes for each day of pile installation. Test cubes should be cured and tested in accordance with ASTM C109 and may be restrained from expansion as described in ASTM C942. The Deep Foundation Institute recommends testing two grout cubes at 7 days, two at 28 days, and keeping two as hold.

ACIP Pile Installation and Monitoring

The installation process makes it inherently difficult to evaluate the integrity of the installed auger cast-in-place piles, yet the integrity is important to the load carrying capacity of the piles. A comprehensive construction monitoring and record keeping program is recommended to help reduce the risks associated with improper construction techniques. Construction monitoring should be performed in accordance with the Inspector's Guide to Auger Cast-in-Place Piles prepared by the Deep Foundation Institute. We recommend that construction monitoring be performed by qualified personnel independent of the Contractor.

There are several aspects of the installation procedure that can be monitored to aid in assessing whether the auger cast-in-place pile is being installed properly. These aspects are:

- Viscosity of the grout mixture to be pumped;
- Initial grout placement prior to raising the augers and resulting grout head observed upon completion of pile installation;
- Incremental grout factor (volume of grout pumped relative to the theoretical volume) computed over intervals of 5 feet or less as the auger is withdrawn;
- Uniformity of grout placement and computed grout factor along the length of the completed pile;
- Continuous grout placement and auger withdrawal without delays or grout pressure fluctuations; and
- Unobstructed and successful reinforcing steel placement in a timely manner following completion of grout placement.

Records kept during construction monitoring should include these aspects of the pile installation.

Aeration Basin Recommendations

In Section 11.2 of our report, we recommended that mat foundations bearing at a depth of 2 feet or more below exterior grade be designed using an allowable bearing pressure of 2,000 psf. However, we understand the aeration basins will apply a pressure on the order of 4,500 psf at the planned bearing depth of about 4 to 5 feet below existing grade. In order to increase the bearing capacity to about 4,500 psf at that elevation, we recommend scarifying the upper 8 inches of the sands exposed at the bearing grade and recompacting it with a vibratory roller according to the recommendations in Section 11.1.8 of our report (95 percent of standard proctor density at plus or minus 2 percent of optimum moisture content).

We appreciate the opportunity to be of service to you during this phase of the project.

Respectfully submitted,
NINYO & MOORE
TBPE Firm No. F-9782





Richard J. Whitt, PE
Senior Engineer

RJW/JTS/ls

5/8/2020

Distribution: (1) Addressee (via email)

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2 – Boring Locations
3 – Lateral Pile Analysis – Fixed-Head Condition
4 – Lateral Pile Analysis – Free-Head Condition

APPENDICES

A – Boring Logs
B – Laboratory Testing

FIGURES



Source: US Geological Survey 7.5-minute topographic map, Galveston, Texas, 2016.

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NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

FIGURE 1

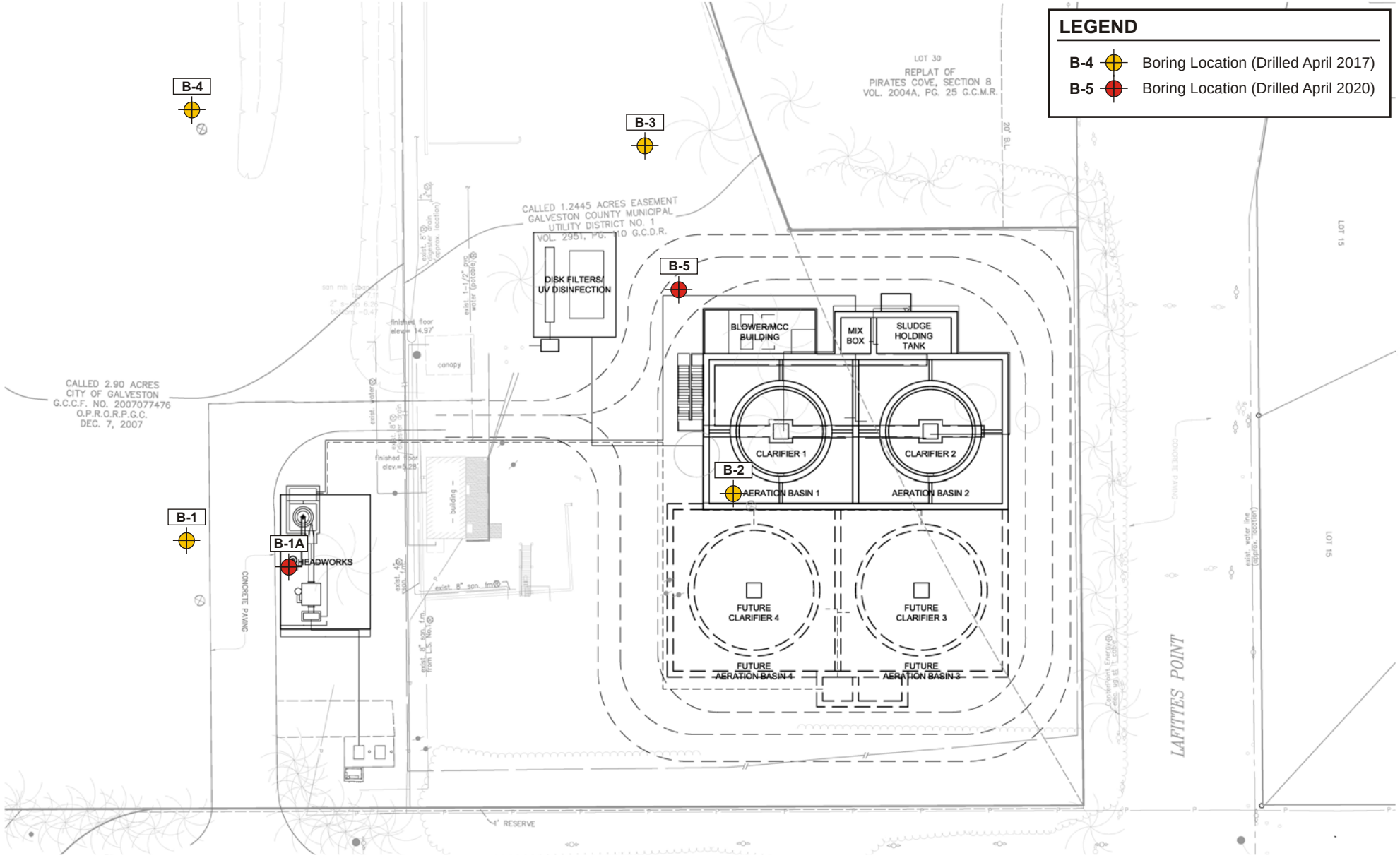
SITE LOCATION

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

700660001 | 5/20

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Geotechnical & Environmental Sciences Consultants

bsm file no: 0660vmap0420



NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

bsm file no: 0660blm0420

FIGURE 2

BORING LOCATIONS

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

700660001 | 5/20

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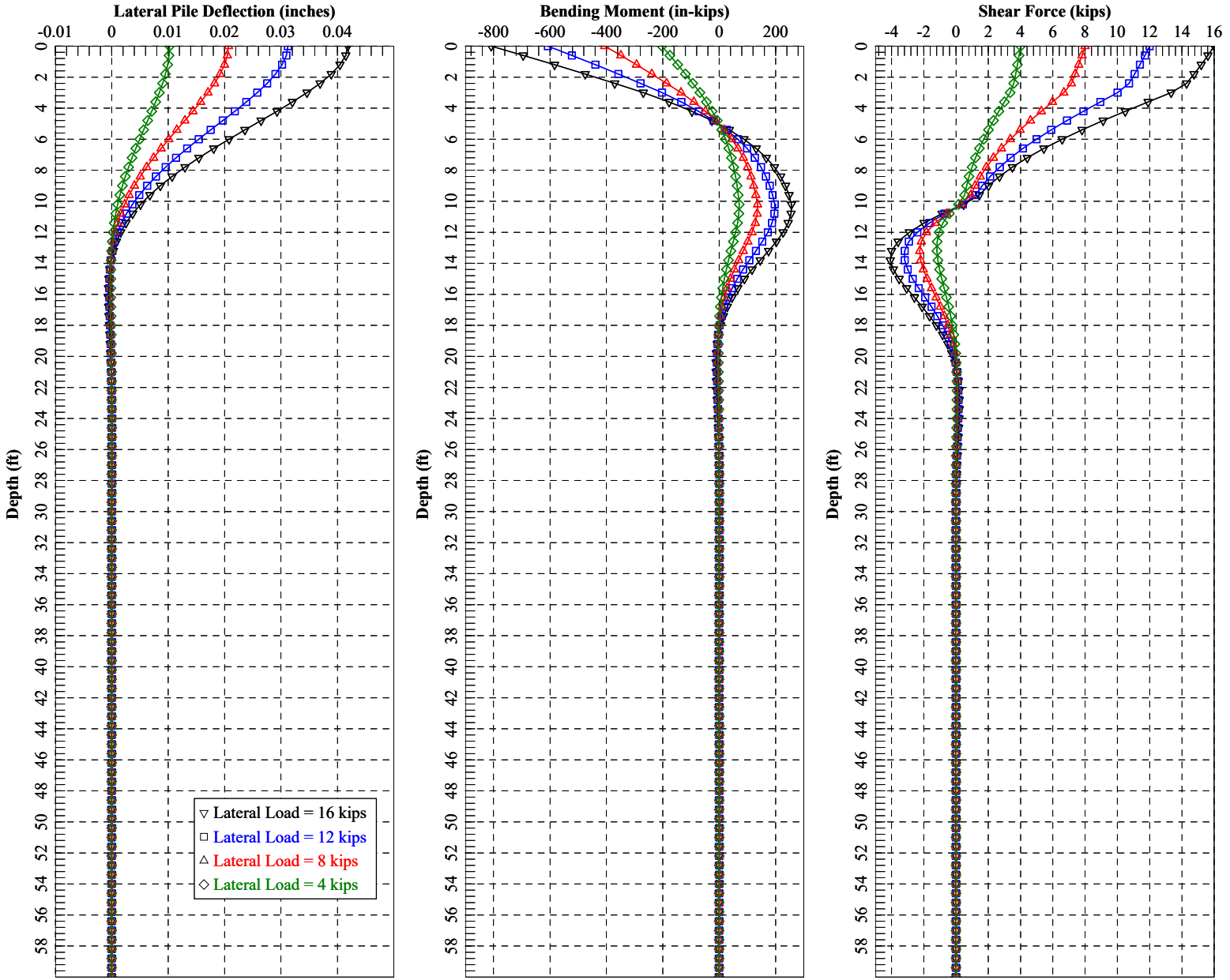


FIGURE 3

LATERAL PILE ANALYSIS - FIXED-HEAD CONDITION

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

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bsm file no: 0660fix0520

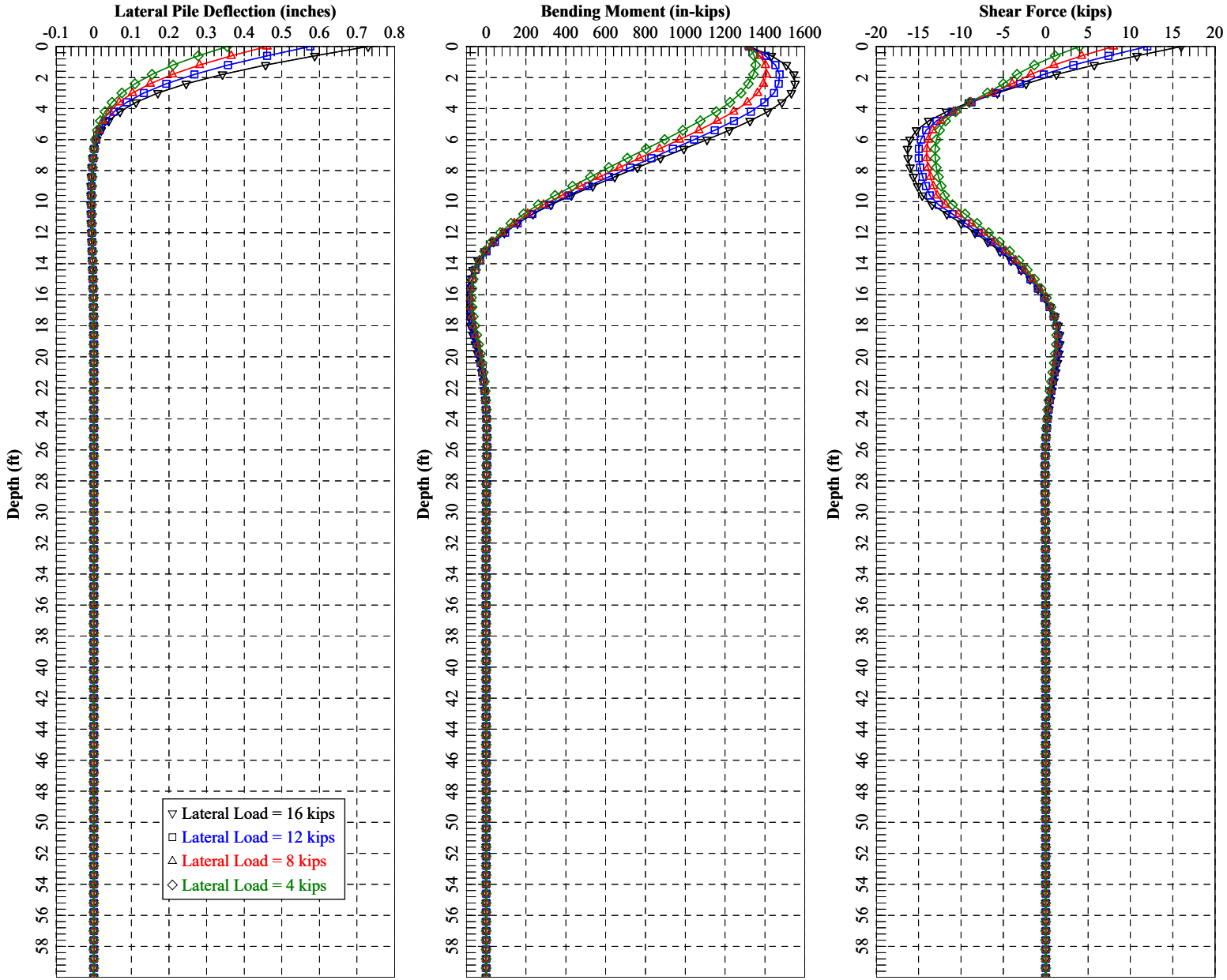


FIGURE 4

LATERAL PILE ANALYSIS - FREE-HEAD CONDITION

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

700660001 | 5/20

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bsm file no: 0660free0520

APPENDIX A

Boring Logs

FIGURE A-1

BORING LOGS

Field Procedure for the Collection of Relatively Undisturbed Samples

Relatively undisturbed soil samples were obtained in the field using the following method.

Shelby Tube

The Shelby tube is a seamless, thin-walled, steel tube having an external diameter of 3 inches and a length of 30 inches. The tube is connected to the drill rod or a hand tool and pushed into an undisturbed soil mass to obtain a relatively undisturbed sample of soft, cohesive soil in general accordance with ASTM D 1587. When the tube is almost full (to avoid over-penetration), it is withdrawn from the boring. These samples are removed from the sampling tubes in the field, assessed visually, and evaluated for consistency using a pocket penetrometer. A selected portion of each sample is then wrapped in aluminum foil and sealed in a plastic bag for use in future visual assessments and possible testing in our laboratory.

Field Procedure for the Collection of Disturbed Samples

Disturbed soil samples were obtained in the field using the following methods.

The Standard Penetration Test (SPT) Sampler

Disturbed samples of earth materials were obtained by means of a split spoon sampler during Standard Penetration Testing. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of $1^{3}/_{8}$ inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were removed from the sampler, visually classified, bagged, sealed and transported to the laboratory for testing.

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

[A]Based on the material passing the 3-in. (75-mm) sieve

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

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

[D]$Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2 / (D_{10} \times D_{60})$

[E]If soil contains ≥ 15% sand, add "with sand" to group name.

[F]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[G]If fines are organic, add "with organic fines" to group name.

[H]Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[I]If soil contains ≥ 15% gravel, add "with gravel" to group name.

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

[K]If soil contains 15 to <30% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L]If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

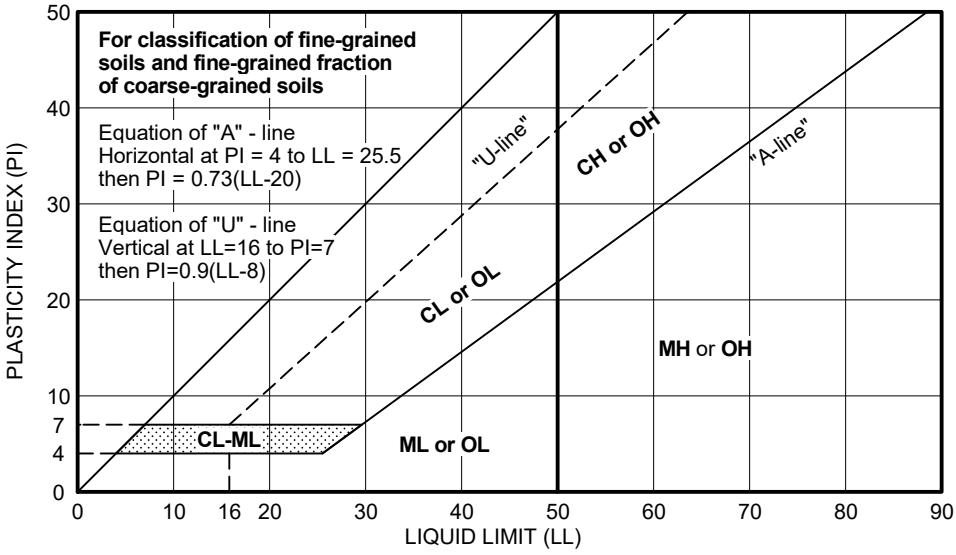
[M]If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N]PI ≥ 4 and plots on or above "A" line.

[O]PI < 4 or plots below "A" line.

[P]PI plots on or above "A" line.

[Q]PI plots below "A" line.



BASED ON TABLE 1 "SOIL CLASSIFICATION CHART" ASTM D 2487-11

FIGURE A-2

SOIL CLASSIFICATION CHART

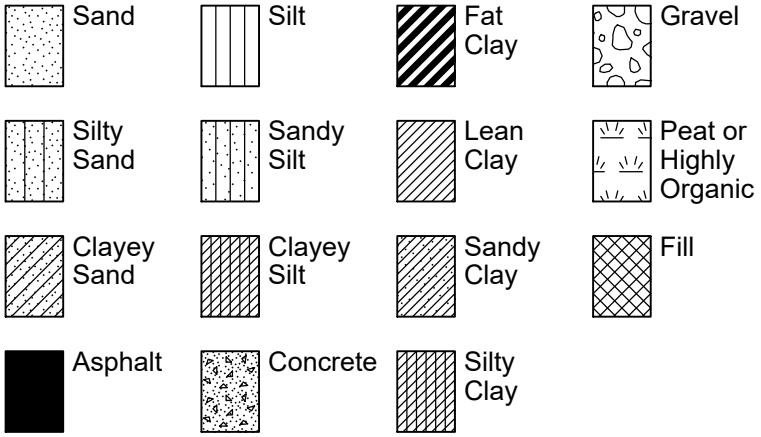
PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

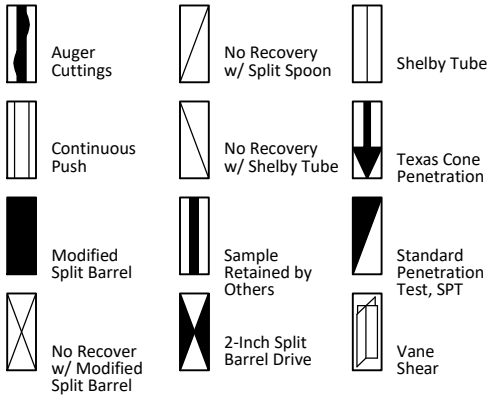
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SYMBOLS

SOIL TYPES



SAMPLER TYPES



TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using available invormation from the field and laboratory studies. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-11 and D2488-09a, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2015.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Lines delineating subsurface strata on the boring logs are intended to group soils having similar engineering properties and characteristics. They should be considered approximate as the actual transition between soil types (strata) may be gradual.

RELATIVE DENSITY

Penetration Resistance Blows per ft	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
> 50	Very Dense

COHESIVE STRENGTH

Resistance Blows per ft	Consistency	Cohesion ksf
0 - 2	Very Soft	0 - 0.25
3 - 4	Soft	0.25 - 0.5
5 - 8	Firm	0.5 - 1.0
9 - 15	Stiff	1.0 - 2.0
16 - 30	Very Stiff	2.0 - 4.0
> 30	Hard	> 4.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0 - 5	None
6 - 10	Low
11 - 20	Moderate
21 - 40	Plastic
> 40	Highly Plastic

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

DEPTH, feet	FIELD				CLASSIFICATION						SHEAR STRENGTH			USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
	WATER LEVEL	SYMBOL	SAMPLE TYPE	BLOWS PER FOOT	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	PASSING NO. 200 SIEVE, %	UNCONFINED OR Q-TYPE COMPR., ksf	TORVANE, tsf	POCKET PEN., ksf		
0															Boring drilled without sampling to 43 feet.
10															
20															

DATE DRILLED 4/15/2020 BORING NO. B-1A

GROUND ELEVATION ~ 5 ft MSL SHEET 1 OF 3

METHOD OF DRILLING 4¼" Straight Flight Auger & Mud Rotary (Patino - Buggy)

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY Patino LOGGED BY RAG REVIEWED BY RJW

GROUND WATER OBSERVATIONS

▽ First Observed (ft): None

▼ After Drilling (ft): Dry

▼ After ____ Hours (ft): ____

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	5/20	A-3a

DATE DRILLED 4/15/2020 BORING NO. B-1A

GROUND ELEVATION ~ 5 ft MSL SHEET 2 OF 3

METHOD OF DRILLING 4¼" Straight Flight Auger & Mud Rotary (Patino - Buggy)

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY Patino LOGGED BY RAG REVIEWED BY RJW

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR., ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
															Boring drilled without sampling to 43 feet. *(continued)*
40															
					95	30					2.2		2.5	CH	BARRIER ISLAND DEPOSITS: Reddish brown and light gray, moist, very stiff, fat CLAY; ferrous nodules; sand pockets.
						18							1.75	CL	Reddish brown and light gray, moist, stiff, sandy lean CLAY.
50				19		25				29				SM	Reddish brown, wet, medium dense, silty SAND.
				4		34	44	22	22	92				CL	Gray, wet, soft, lean CLAY.

GROUND WATER OBSERVATIONS

▽ First Observed (ft): None

▼ After Drilling (ft): Dry

▽ After ___ Hours (ft): ___

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	5/20	A-3b

DATE DRILLED 4/15/2020 BORING NO. B-1A

GROUND ELEVATION ~ 5 ft MSL SHEET 3 OF 3

METHOD OF DRILLING 4¼" Straight Flight Auger & Mud Rotary (Patino - Buggy)

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY Patino LOGGED BY RAG REVIEWED BY RJW

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR, ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
					90	32	35	20	15	97	0.7	0.75	0.75	CL	BARRIER ISLAND DEPOSITS: Gray, wet, soft, lean CLAY. (CONT'D) Firm; silt seams.
					81	42					1.2		1.25	CH	Gray, moist, stiff, fat CLAY; ferrous nodules and sand pockets.
70															Total Depth = 70 feet. Free water was not observed during or on conclusion of drilling operations. Mud rotary drilling methods were used below 5 feet. Boring was backfilled with soil cuttings upon completion on 4/15/2020. Note: Groundwater, though not encountered in this boring at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors discussed in the report. The ground elevation shown above is an estimation only. It is based on interpretation reviewed for the purpose of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
80															

GROUND WATER OBSERVATIONS

▽ First Observed (ft): None

▼ After Drilling (ft): Dry

▼ After ____ Hours (ft): ____

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	5/20	A-3c

DATE DRILLED 4/15/2020 BORING NO. B-5

GROUND ELEVATION ~ 6 ft MSL SHEET 1 OF 3

METHOD OF DRILLING 4¼" Straight Flight Auger & Mud Rotary (Patino - Buggy)

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY Patino LOGGED BY RAG REVIEWED BY RJW

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR., ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
0						10								SM	BARRIER ISLAND DEPOSITS: Light brown, moist, silty SAND.
				8											Loose.
				7		21									
	▽			11											Medium dense.
				20		26									Wet.
10															
				2		30	30	17	13	36				SC	Gray, wet, very loose, clayey SAND.
					101	25					1.2		2.0	CH	Gray, moist, stiff to very stiff, fat CLAY; sand pockets.
20															
						22	31	19	12	82			1.0	CL	Reddish brown and light gray, moist, firm to stiff, lean CLAY with sand.
						27	33	20	13	95			0.75	CL	Reddish brown, moist, firm, lean CLAY.

GROUND WATER OBSERVATIONS

▽ First Observed (ft): 8

▼ After Drilling (ft): Dry

▼ After ___ Hours (ft): ___

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	5/20	A-4a

DATE DRILLED 4/15/2020 BORING NO. B-5

GROUND ELEVATION ~ 6 ft MSL SHEET 2 OF 3

METHOD OF DRILLING 4¼" Straight Flight Auger & Mud Rotary (Patino - Buggy)

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY Patino LOGGED BY RAG REVIEWED BY RJW

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR., ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
					107	22					0.5		1.75	CL	BARRIER ISLAND DEPOSITS: Reddish brown, moist, firm, lean CLAY. (CONT'D) Stiff, silt layer at 33 feet.
				13										CH	Reddish brown, moist, stiff, fat CLAY.
40						27	66	25	41				3.0		Very stiff; sand pockets.
					102	24					2.1		2.25		Light gray and reddish brown; calcareous and ferrous nodules.
50														SM	Reddish brown, wet, medium dense, silty SAND.
				24											
														CL	Gray, moist, firm, lean CLAY with sand.
				7		31	45	20	25	85					

GROUND WATER OBSERVATIONS

▽ First Observed (ft): 8

▼ After Drilling (ft): Dry

▼ After ___ Hours (ft): ___

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	5/20	A-4b

DATE DRILLED 4/15/2020 BORING NO. B-5

GROUND ELEVATION ~ 6 ft MSL SHEET 3 OF 3

METHOD OF DRILLING 4¼" Straight Flight Auger & Mud Rotary (Patino - Buggy)

DRIVE WEIGHT 140 lbs (Cathead) DROP HEIGHT 30 inches

SAMPLED BY Patino LOGGED BY RAG REVIEWED BY RJW

DEPTH, feet	FIELD: WATER LEVEL	FIELD: SYMBOL	FIELD: SAMPLE TYPE	FIELD: BLOWS PER FOOT	CLASSIFICATION: DRY UNIT WEIGHT, pcf	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	CLASSIFICATION: PASSING NO. 200 SIEVE, %	SHEAR STRENGTH: UNCONFINED OR Q-TYPE COMPR, ksf	SHEAR STRENGTH: TORVANE, tsf	SHEAR STRENGTH: POCKET PEN, ksf	USCS GROUP SYMBOL	DESCRIPTION / INTERPRETATION
					92	32	37	22	15	99	0.7	0.4	0.75	CL	BARRIER ISLAND DEPOSITS: Gray, moist, firm, lean CLAY with sand. (CONT'D) Decrease in sand content.
70				5	85	42 39					0.5	0.45	0.5	CH	Gray, wet, soft to firm, fat CLAY.
80															Total Depth = 72 feet. Free water was observed during dry drilling operations at 8 feet and the borehole caved after 5 minutes. Mud rotary drilling methods were used below 10 feet due to caving soils. Boring was backfilled with soil cuttings upon completion and pavement patched with like-materials on 4/15/2020. Note: Groundwater may rise to a higher level than that measured in our boring due to seasonal variations in precipitation and several other factors discussed in the report. The ground elevation shown above is an estimation only. It is based on interpretation reviewed for the purpose of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

GROUND WATER OBSERVATIONS

▽ First Observed (ft): 8

▼ After Drilling (ft): Dry

▼ After ____ Hours (ft): ____

BORING LOG

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
GALVESTON, TEXAS

PROJECT NO.	DATE:	FIGURE
700660001	5/20	A-4c

APPENDIX B

Laboratory Testing

FIGURE B-1

LABORATORY TESTING

Classification

Soils were visually and texturally classified using the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the boring logs in Appendix A and in the following summary tables in Appendix B.

Moisture Content

The moisture content of samples obtained from the exploratory borings was evaluated in general accordance with ASTM D 2216. The test results are presented on the boring logs in Appendix A and the Summary of Laboratory Results, Figure B-4.

No. 200 Wash

An evaluation of the percentage of particles finer than the No. 200 sieve in selected soil samples was performed in general accordance with ASTM D 1140. The results of the tests are presented on Figure B-2, on the boring logs in Appendix A, and in the Summary of Laboratory Results, Figure B-4.

Atterberg Limits

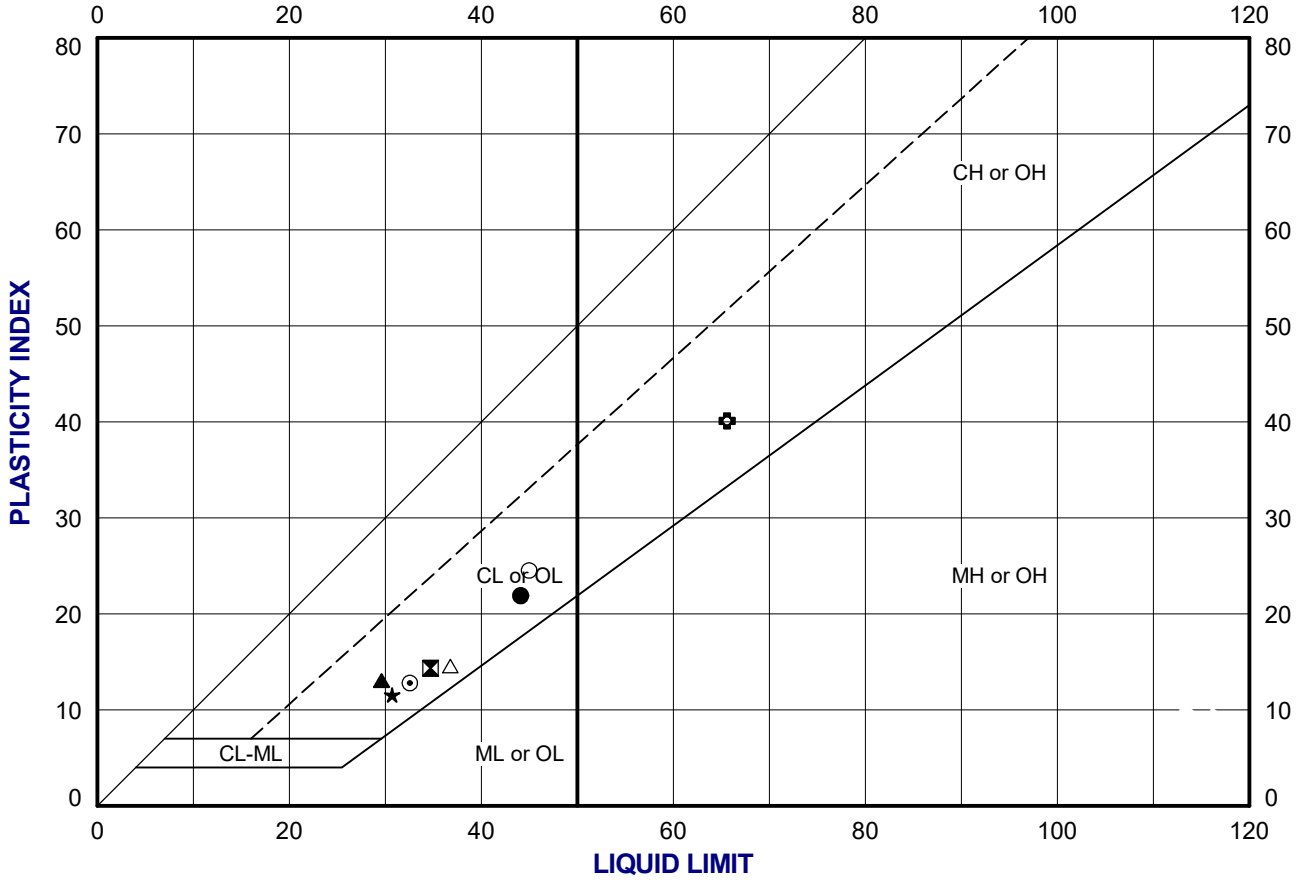
Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D 4318 (Method B). These test results were utilized to evaluate the soil classification in accordance with the Unified Soil Classification System (USCS). The results of these tests are presented on Figure B-3, on the boring logs in Appendix A, and in the Summary of Laboratory Results, Figure B-4.

Compression Tests

Unconsolidated-undrained compression tests were performed on relatively undisturbed samples in general accordance with ASTM D 2850. The test results are shown on the boring logs in Appendix A and in the Summary of Laboratory Results, Figure B-4.

SAMPLE LOCATION	DEPTH (feet)	DESCRIPTION	PERCENT PASSING NO. 4	PERCENT PASSING NO. 200	USCS
B-1A	53.5 - 55	Silty SAND	100.0	29.1	SM
B-1A	58.5 - 60	Lean CLAY	100.0	91.5	CL
B-1A	63 - 65	Lean CLAY	100.0	96.9	CL
B-5	13.5 - 15	Clayey SAND	100.0	35.5	SC
B-5	23 - 25	Lean CLAY w/ Sand	100.0	81.7	CL
B-5	28 - 30	Lean CLAY	100.0	94.7	CL
B-5	58.5 - 60	Lean CLAY w/ Sand	100.0	84.7	CL
B-5	63 - 65	Lean CLAY w/ Sand	100.0	98.8	CL

SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-1A	58.5 - 60	44	22	22	CL	CL
⊠	B-1A	63 - 65	35	20	15	CL	CL
▲	B-5	13.5 - 15	30	17	13	CL	SC
★	B-5	23 - 25	31	19	12	CL	CL
⊙	B-5	28 - 30	33	20	13	CL	CL
✿	B-5	43 - 45	66	25	41	CH	CH
○	B-5	58.5 - 60	45	20	25	CL	CL
△	B-5	63 - 65	37	22	15	CL	CL
⊗							
⊕							



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D4318.

FIGURE B-3

ATTERBERG LIMIT TEST RESULTS

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS

Borehole	Depth (feet)	Liquid Limit	Plastic Limit	Plasticity Index	Shear Strength (ksf)	%<#200 Sieve	USCS Group Symbol	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-1A	43 - 45				2.2[Q]		CH	30.0	95.1		
B-1A	48 - 50				1.75[P]		CL	18.0			
B-1A	53.5 - 55					29	SM	25.0			
B-1A	58.5 - 60	44	22	22		92	CL	34.0			
B-1A	63 - 65	35	20	15	0.7[Q]	97	CL	32.0	90.2		
B-1A	68 - 70				1.2[Q]		CH	42.0	80.9		
B-5	0 - 2						SM	10.0			
B-5	4.5 - 6						SM	21.0			
B-5	8.5 - 10						SM	26.0			
B-5	13.5 - 15	30	17	13		35	SC	30.0			
B-5	18 - 20				1.2[Q]		CH	25.0	101.1		
B-5	23 - 25	31	19	12	1.0[P]	82	CL	22.0			
B-5	28 - 30	33	20	13	0.75[P]	95	CL	27.0			
B-5	33 - 35				0.5[Q]		CL	22.0	107.0		
B-5	43 - 45	66	25	41	3.0[P]		CH	27.0			
B-5	48 - 50				2.1[Q]		CH	24.0	102.2		
B-5	58.5 - 60	45	20	25		85	CL	31.0			
B-5	63 - 65	37	22	15	0.7[Q]	99	CL	32.0	91.7		
B-5	68.5 - 70						CH	42.0			
B-5	70 - 72				0.5[Q]		CH	39.0	85.3		

*Void ratio based on assumed specific gravity of 2.70.

U = Unconfined Compr; Q = Q-Type; T = Torvane; P = Pocket Pen

FIGURE B-4

SUMMARY OF LABORATORY RESULTS

PIRATES BEACH WASTEWATER TREATMENT PLANT IMPROVEMENTS
MOYENNE PLACE NEAR LAFITTES POINT
GALVESTON, TEXAS