CONTRACT DOCUMENTS

AND

TECHNICAL SPECIFICATIONS

FOR

UTMB EST REHABILITATION

City of Galveston, Texas

August 2025

Texas Registered Engineering Firm F-928
11700 Katy Freeway, Suite 800
Houston, Texas 77079
281-920-6588

TECHNICAL SPECIFICATIONS
FOR

CITY OF GALVESTON

UTMB ELEVATED STORGAE TANK REHABILITATION

August 2025

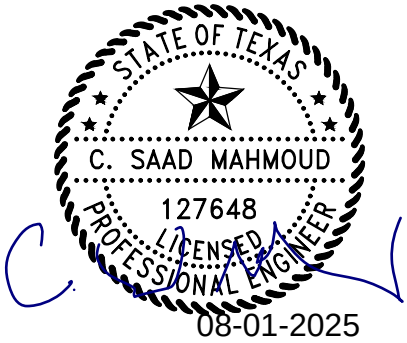
Division 1-2, 3-4, 5, 8-9, 11

Prepared By:
Kimley-Horn and Associates, Inc.
11700 Katy Freeway, Suite 800
Houston, TX 77079
State of Texas Registration F-928

TECHNICAL SPECIFICATIONS
FOR

CITY OF GALVESTON

UTMB ELEVATED STORAGE TANK REHABILITATION



August 2025

Specification 03400
Division 13
Division 16

Prepared By:
Burrer Engineering, Inc.
17217 N. Eldridge Parkway
Tomball, Texas 77377

TBPE FIRM NO. F-20420

UTMB EST REHABILITATION

CITY OF GALVESTON
TEXAS

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City of Galveston

REQUEST FOR PROPOSAL

Proposal Reference Number: RFP 26-07

Project Title: UTMB Elevated Storage Tank Rehabilitation

Proposal Closing Date: 9:00 A.M.(CST), Thursday, April 16, 2026

Proposals submitted after the above deadline will <u>not</u> be accepted.

KEY EVENTS SCHEDULE

PROJECT NAME:	**UTMB Elevated Storage Tank Rehabilitation**
ISSUANCE OF RFP	**February 17, 2026**
PRE-BID: NON-MANDATORY CONFERENCE	**11:00 AM, (CST); Tuesday, March 3, 2026** The pre-proposal conference will allow all Proposers an opportunity to ask representatives relevant questions and clarify provisions of this RFP. **Location: Public Works Building – PWF Training RM** **3015 Market Street** **Galveston, Texas**
DEADLINE FOR QUESTIONS:	**2:00 PM (CST); Tuesday, March 17, 2026** All questions will be answered in the form of an addendum. All questions related to this RFP are to be directed to the following link: UPLOAD YOUR QUESTION(S) HERE
ADDENDA CHECKLIST: **(IF APPLICABLE)**	CHECK HERE FOR ADDENDUMS
SUBMITTAL DEADLINE:	**9:00 AM, (CST); Thursday, April 16, 2026**
SUBMITAL REQUIREMENT:	**Electronic submittals required.** UPLOAD YOUR SUBMITTAL HERE ***The file size limit for upload is 250 mb per document. If the proposal size exceeds the size limit, Proposers are permitted to breakup the proposal into several documents for upload.**
CITY OF GALVESTON COUNCIL AWARD:	A final determination will be made at a future City of Galveston Council meeting. City of Galveston reserves the right to reject any and all Request for Proposals and waive any and all formalities and conditions.
TERM OF SERVICE/PROJECT:	Agreement shall be effective upon issuance of a Notice to Proceed by the City of Galveston until work has been completed to the satisfaction of the City of Galveston unless sooner terminated under the terms set forth herein

REQUEST FOR PROPOSAL

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SECTION 1

INTRODUCTION

1.1 Description of City of Galveston

The City of Galveston (**"COG"**) is an island community with 32-miles of coastline and historic architecture that more than 50,000 residents call home. We are home to a port, a major medical complex, and two universities. The City of Galveston employs more than 800 people to provide essential services to our residents.

The City of Galveston located in Texas is a home rule city, and is governed through a council-manager form of government.

City of Galveston's web page is located at https://www.galvestontx.gov

1.2 Objective of this Request for Proposal

The City of Galveston ("**COG**") is soliciting proposals in response to this Request for Proposal, RFP 26-07 (this "**RFP**"), from qualified vendors to provide UTMB Elevated Storage Tank Rehabilitation (the "**Services**"). The Services are more specifically described in **Section 3** (Scope of Work) of this RFP.

COG reserves the right to award multiple Agreements as a result of this RFP if deemed in the best interest of COG. COG makes no representations of any kind that an award will be made as a result of this RFP.

COG is soliciting competitive sealed submissions from vendors having suitable qualifications and experience providing services in accordance with the terms, conditions and requirements set forth in this RFP. This RFP provides sufficient information for interested parties to prepare and provide submissions for consideration by COG.

1.3 Public Information

Proposer is hereby notified that COG strictly adheres to all statutes, court decisions and the opinions of the Texas Attorney General with respect to disclosure of public information.

COG 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 Agreement award. If the Proposer has notified COG, in writing, that the Proposal Document contains trade secrets or confidential information, COG 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 COG be liable for disclosure of such information by COG in response to a request, regardless of COG's failure to take any such reasonable steps, even if COG is negligent in failing to do so.

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

chapter. Vendor or company acknowledges that the solicitation is part of any resulting agreement of the solicitation.

1.4 Type of Agreement

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

An award of an agreement to a vendor(s) does not guarantee the vendor(s) that COG shall issue any Purchase Order(s) for the Proposer's goods or services, or guarantee any particular volume use, number, or sales.

Proposers should be aware that the contents of the successful proposal will become a part of the subsequent contractual documents. Failure of the Proposer to accept this obligation may result in the cancellation of any award.

By submitting a proposal, Proposer further warrants and represents that he/she has become fully acquainted with the conditions, facts, and circumstances relating to providing the services/products required under this RFP. The failure or omission of Proposer to acquaint himself/herself with existing conditions, facts, and circumstances, shall in no way relieve him/her of any obligation with respect to his/her proposal and any ensuing agreement.

Each Proposer acknowledges that COG has made a reasonable attempt to provide the Proposer with relevant data. The Proposer, therefore, waives any right of voidance of the agreement based upon any expressed or implied warranty or representation that the pricing or activity data provided discloses all requirements, risks or exposures known to exist in the provision of the services being requested.

1.5 Clarifications and Interpretations

Proposers shall promptly notify the COG of any omissions, ambiguity, inconsistency or error that they may discover upon examination of this RFP. COG 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.

COG may, in its sole discretion, respond in writing to written inquiries concerning this RFP. Only COG's responses that are made by formal written Addenda will be binding on COG. Any verbal responses, written interpretations or clarifications other than Addenda to this RFP will be without legal effect. All Addenda issued by COG prior to the Submittal Deadline will be and are hereby incorporated as a part of this RFP for all purposes.

Proposers are required to acknowledge receipt of each Addendum as specified in this Section. The Proposer must acknowledge all Addenda by completing, signing and returning the Addenda Checklist. The Addenda Checklist must accompany the Proposer's proposal.

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 COG website. All such addenda issued by COG prior to the submittal deadline shall be considered part of the RFP. COG shall not be bound by any reply to an inquiry unless such reply is made by such formal written addendum.

1.6 Proposal Evaluation Process

The evaluation of the Proposals shall be based on the requirements and percentages described in **Section 2.2** of this RFP. All properly submitted Proposals will be reviewed, evaluated, and ranked by COG.

An award of an agreement 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 COG's purchasing policy. All proposals submitted by the Submittal Deadline, accompanied by the number of completed and signed originals that are required by this RFP, will be opened publicly to identify the name of each Proposer submitting a proposal. Any proposals that are not submitted by the Submittal Date, or that are not accompanied by the number of completed and signed originals by this RFP, will be rejected by COG as non-responsive due to material failure to comply with advertised specifications.

If the Proposal Document is incomplete or otherwise fails to conform to the requirements of the RFP, COG alone will determine whether the variance is so significant as to render the Proposal non-responsive. After the opening of the proposals and upon completion of the initial review and evaluation of the proposals, COG may invite one or more selected Proposers to participate in oral presentations. COG will use commercially reasonable efforts to avoid public disclosure of the contents of a proposal prior to selection of Vendor.

Discussions may not be initiated by proposers. These discussions will be limited to issues and topics brought forth by the COG. 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 COG shall be grounds for disqualification. Vendors shall not contact any COG personnel during the proposal process without the express permission from the COG's Purchasing Manager.

COG may make the selection of Vendor on the basis of the proposals initially submitted, without discussion, clarification or modification. In the alternative, COG may make the selection of Vendor on the basis of negotiation with any of the Proposers. In conducting such negotiations, COG will use commercially reasonable efforts to avoid disclosing the contents of competing proposals.

At COG's sole option and discretion, COG may discuss and negotiate all elements of the proposals submitted by selected Proposers within a specified competitive range. For purposes of negotiation, COG may establish, after an initial review of the proposals, a competitive range of acceptable, or potentially acceptable, proposals composed of the highest rated proposal(s). In that event, COG will defer further action on proposals not included within the competitive range pending the selection of Vendor; provided, however, COG reserves the right to include additional proposals in the competitive range, if deemed to be in the best interests of COG.

After submission of a proposal, but before final selection of Vendor is made, COG may permit a Proposer to revise its proposal in order to obtain the Proposer's **best and final offer (BAFO)**. In that event, representations made by Proposer in its revised proposal, including price and fee quotes, will be binding on Proposer. COG will provide each Proposer within the competitive range with an equal opportunity for discussion and revision of its proposal. COG is not obligated to select the Proposer offering the most attractive economic terms if that Proposer is not the most advantageous to COG overall, as determined by COG.

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 vendor. 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.

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

COG reserves the right to (a) enter into an agreement for all or any portion of the requirements and specifications set forth in this RFP with one or more Proposers, (b) reject any and all proposals and re-solicit proposals, or (c) reject any and all proposals and temporarily or permanently abandon this selection process, if deemed to be in the best interests of COG. Proposer is hereby notified that COG will maintain in its files concerning this RFP a written record of the basis upon which a selection, if any, is made by COG.

1.7 COG's Reservation of Rights

COG may evaluate the Proposals based on the anticipated completion of all or any portion of the Project. COG reserves the right to divide the Project into multiple parts, to reject any and all Proposals and re-solicit for new Proposals, or to reject any and all Proposals and temporarily or permanently abandon the Project. COG makes no representations, written or oral, that it will enter into any form of agreement with any respondent to this RFP for any project and no such representation is intended or should be construed by the issuance of this RFP. Acceptance of a Proposal for consideration does not waive this reservation of rights, nor does it imply any obligation by COG.

COG reserves the right to award one agreement for some or all the requirements proposed or award multiple agreements for various portions of the requirements to different Proposers.

If the best proposer's Proposal is significantly unbalanced either in excess of or below reasonable cost analysis values normally associated with the work, the Proposal will be considered as non-responsive and will not be considered for award. COG reserves the right to evaluate and determine the next qualified Proposal for consideration of Award.

1.8 System for Award Management (SAM.GOV)

All vendors contracting with COG 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 COG Council. Registering online is accomplished on the SAM website here: https://sam.gov/content/home

1.9 No Reimbursement for Costs

Proposer acknowledges and accepts that any costs incurred from the Proposer's participation in this RFP shall be at the sole risk and responsibility of the Proposer. Proposer understands and agrees that (1) this RFP is a solicitation for proposals and COG

has made no representation written or oral that one or more agreements with COG will be awarded under this RFP; (2) COG issues this RFP predicated on COG's anticipated requirements for the Services, and COG has made no representation, written or oral, that any particular scope of services will actually be required by COG; and (3) Proposer will bear, as its sole risk and responsibility, any cost that arises from Proposer's preparation of a proposal in response to this RFP.

1.10 RFP Withdrawals and/or Amendments

COG reserves the right to withdraw this RFP for any reason. COG reserves the right to amend any aspect of this RFP by formal written Addendum prior to the Proposal submittal deadline.

1.11 Tax Exempt Status

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

1.12 Compliance with House Bills 13, 19, 89 and Texas Government Code Chapter 2252, Section 2252.152

COG Requires Proposer to verify that they are in-compliance with House Bills and Texas Government Codes. Refer to **Section 5** for these documents

1.13 Proposal 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 an agreement has been awarded by the COG.

1.14 Equal Opportunity Employer

COG is an equal opportunity employer and does not discriminate in awarding agreements or employment of persons because of their race, sex, age, religion, national origin, veteran, disabled or handicap status or any other characteristic protected by law. COG requires companies with which it conducts business to be equal opportunity employers and comply with all applicable federal, state and municipal laws and regulations regarding contracting and employment practices.

1.15 Conflict of Interest Questionnaire (Form CIQ)

A person or business, and their agents, who seek to contract or enter into an agreement with COG, are required by Texas Local Government Code, Chapter 176, to file a conflict of interest questionnaire (FORM CIQ) which is found in **Section 5**. The form must be filed with the COG Secretary no later than seven (7) days after the date the person or business begins agreement discussions or negotiations with COG, or submits an application, response to a request for proposals or proposals, correspondence, or other writing related to any potential agreement with COG. If no conflict exists the proposer must mark the form Not Applicable or NA and return with the proposal packet.

1.16 Disclosure of Interested Parties Form 1295

A person or business, who enters into an agreement with COG, 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 an agreement between the vendor and the COG. Do not submit this form unless you receive an award letter from COG.**
https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm

1.17 Protest Procedure

Any actual or prospective proposer who is allegedly connected with the solicitation or award of an offer may protest. The protest will be submitted in writing to the COG'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 agreement 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 COG Purchasing Manager shall ask the protester deliver, via electronic mail, the protest to relevant parties.

1.18 Pursuant to Sec. 2-341 of the COG Code – Declaration of Policy

A. It is the policy of COG 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 COG 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 COG and other public and private sector business entities.

B. Provided, however, nothing herein shall require COG 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 COG may otherwise lawfully award the contract to someone other than the lowest responsive, responsible Proposer.

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

1.19 Insurance Requirements

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"

SECTION 2

NOTICE TO PROPOSER

2.1 Submittal Deadline

Refer to Key Events Schedule.

2.2 Criteria for Selection

Proposer is encouraged to propose terms and conditions offering the maximum benefit to COG in terms of:

Scoring Criteria:

2.2.1.1 Past Performance on similar projects of size and scope.....…….... (25%)
2.2.1.2 Costs ……..……..…… (40%)
2.2.1.3 Overall Experience of Project Manager & Site Superintendent….. (25%)
2.2.1.4 Proposed Schedule…… (10%)

An evaluation team from COG will evaluate proposals. The evaluation of proposals and the selection of Vendor will be based on the information provided by Proposer in its proposal. COG may give consideration to additional information, if COG deems such information relevant.

SECTION 3

Scope of Work

3.1 Project Title: UTMB Elevated Storage Tank Rehabilitation

3.2 Special Conditions (Bonds, Federal Clauses, etc..)

Project duration to final completion: 240 calendar days.

Project budget: $1,650,000.

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.

Liquidated Damages are $1500.00 per day.

3.3 Brand Manufacture Reference

COG has determined that any manufacturer's brand defined in the Scope of Services meets the COG's product and support need. The manufacturer's reference is not intended to be restrictive, and is only descriptive of the type and quality COG 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. COG reserves the right to determine products and support of equal value, and whether other brands or models meet the COG's product and support needs.

3.4 COG's Payment Terms

COG's standard payment terms for services are "Net 30 days

3.5 Scope of Work – Requirements

Please refer to the Technical Specifications and Index of Drawings

SECTION 4

Appendices

Appendix A – Proposal Document
Appendix B – Conflict of Interest
Appendix C – House Bills 13, 19, 89
Appendix D – Property Tax Statement
Appendix E – Nepotism Statement
Appendix F – Non-Collusion Statement
Appendix G – Certification Regarding Debarment
Appendix H – ACH Form

Appendix A – Proposal Document

Submittal Checklist: (To determine validity of Proposal)

_____Appendix A must be included in the submittal.

_____Appendix B – G 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 13, 19, 89 Verification

☐ Appendix D – Property Tax Statement

☐ Appendix E – Nepotism Statement

☐ Appendix F – Non-Collusion Statement

☐ Appendix G – Certification Regarding Debarment

All Proposals delivered to the City of Galveston shall include this page with the submittal.			
RFP Number:	**26-07**		
Project Title:	**UTMB Elevated Storage Tank Rehabilitation**		
Unique Entity Identifier (UEI)			
Proposer Information:			
Proposer's Legal Name:			
Address:			
City, State & Zip			
Federal Employers Identification Number #			
Phone Number:		**Fax Number:**	
E-Mail Address:			

Proposer Authorization

I, the undersigned, have the authority to execute this Proposal in its entirety as submitted and enter into an agreement on behalf of the Proposer.

Printed Name and Position of Authorized Representative: _____

Signature of Authorized Representative: _____

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

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 6 OF THE PROPOSAL.

Appendix C - House Bills 13, 19 & 89 Verification

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:

Discrimination Against Firearm Entities – 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.

Pursuant to Sections 2271.001, 2271.002, 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.*

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 2271; depose and verify under oath that the Company, under the provisions of Subtitle A, Title 8, Government Code, is amended by adding Chapter 809; do hereby depose and verify under oath that the Company, under the provisions of Subtitle F, Title 10, Government Code, is amended by adding Chapter 2274 will not discriminate and/or boycott any of these provisions outlined and defined in House Bills 13, 19 and 89.

_____ _____

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 6 OF THE PROPOSAL.

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 6 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 6 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.

PROPOSER_____

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 6 OF THE PROPOSAL.

Appendix G – Document 00435
The City of Galveston, Texas

PROPOSER'S CERTIFICATION REGARDING DEBARMENT, 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 6 OF THE PROPOSAL.

Appendix H – 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 provide for the City of Galveston.

Sincerely,

Sincerely,

Csilla Ludanyi

Csilla Ludanyi
Finance Director

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: _____

ACH Remittance Email: _____

FOR CITY USE ONLY:

Verified by: _____ Date Verified: _____

RETURN THIS FORM ONLY UPON AWARD.

SECTION 5

REFERENCES

References – This section is required.

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:	

SECTION 6
SUBMISSION OF PROPOSAL

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.

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. Proposers 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 **Key Events Schedule**. It is the Proposer'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 COG online submittal portal, shall be the official time of receipt. COG 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 Section 6.1.*** 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. COG only accepts proposals that are submitted through the online portal. The link is provided on the **Key Events Schedule**. No hand delivered or mailed submittals will be considered and will be marked "Non-responsive".

G. Questions and Responses: 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 COG 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 the **Key Events Schedule**.

6.1 Proposal Submittal Order

Proposer is instructed to complete, sign, and return the following documents in the following order as a part of its proposal. If Proposer fails to return each of the following items with its proposal, then COG may consider this as Non-Responsive and reject the proposal:

6.1.1 Signed and Completed Appendix A – Proposal Document **(Section 4)**
6.1.2 Signed and Completed Appendix B – Form CIQ **(Section 4)**
6.1.3 Signed and Completed Appendix C – House Bills 13, 19, 89 Verifications **(Section 4)**
6.1.4 Signed and Completed Appendix D – Property Tax Statement **(Section 4)**
6.1.5 Signed and Completed Appendix E – Nepotism Statement **(Section 4)**
6.1.6 Signed and Completed Appendix F – Non-Collusion Statement (**Section 4)**
6.1.7 Signed and Completed Appendix G – Certification Regarding Debarment (**Section 4)**
6.1.8 Signed and Completed Pricing Proposal
6.1.9 Signed and Completed Addenda Checklist (if applicable)
Note: It is the Proposer's responsibility to make sure they have obtained all addenda.
6.1.10 Completed References **(Section 5)**
6.1.11 Signed and Completed Bid Bond (5% of total proposed amount) (if applicable)

CITY OF GALVESTON, TEXAS

UTMB EST Rehabilitation

PROPOSAL FORM

Item No.	Spec No.	Item Description	Bid Qty.	Unit	Unit Price	Bid Amount
PART A - BASE UNIT PRICE TABLE						
1	01505	**Mobilization** cost, including payment bond, performance bond, insurance and moving equipment to project, all in strict accordance with plans and specifications: NOT TO EXCEED 3% OF TOTAL PROJECT BID.	1	LS		
2	09871	**Dehumidification.** Furnish all material, labor, and equipment to install dehumidification system in accordance with contract plans and specifications.	1	LS		
3	09871	**Containment.** Furnish all material, labor, equipment, and superintendence to install coating containment system in accordance with contract plans and specifications.	1	LS		
4	01566	**Storm Water Pollution Prevention Plan (SW3P) and Erosion Control.** Furnish all materials, labor, and equipment to install and maintain SW3P and erosion control measures in accordance with contract plans and specifications.	1	LS		
5	01570	**Traffic Control Plan.** Furnish all materials, labor, and equipment to install and maintain traffic control including traffic control devices, signage, and flaggers, in accordance with contract plans and specifications.	1	LS		
6	02050	**Concrete Curb.** Furnish all material, labor, and equipment to remove and dispose existing concrete curb in accordance with contract plans and specifications.	24	LF		
7	02050	**Concrete Sidewalk.** Furnish all material, labor, and equipment to remove and dispose existing concrete sidewalk, in accordance with contract plans and specifications.	6	SY		
8	02821	**Chain-link Fence.** Furnish all materials, labor, and equipment to remove and replace the existing 6-foot chain link fence with 3-strand barbed wire and install a new chain link fence in accordance with the contract plans and specifications.	244	LF		
9	02105	**Site Restoration and Grading**. Furnish all materials, labor, and equipment to perform site restoration and grading in accordance with contract plans and specifications.	1	LS		
10	02821	**8-foot Gate.** Furnish all materials, labor, and equipment to remove and replace the existing 8-foot gate and install a new 8-foot gate in accordance with the contract plans and specifications.	1	EA		

Item No.	Spec No.	Item Description	Bid Qty.	Unit	Unit Price	Bid Amount
11	See Drawings	**21-foot Cantilever Gate.** Furnish all materials, labor, and equipment to remove and replace the existing 10-foot gate and install a new 21-foot cantilever gate including automatic opener, demolition of existing masonry fence section, in accordance with the contract plans and specifications.	1	EA		
12	02531	**Concrete Driveway.** Furnish all materials, labor, and equipment to install a new concrete driveway in accordance with contract plans and specifications.	94	SY		
13	See Drawings	**Removable Bollard.** Furnish all materials, labor, and equipment to install new removable bollards in accordance with the contract plans and specifications.	6	EA		
14	02521	**Concrete Pads**. Furnish all materials, labor, and equipment to install 6" concrete pad for valve pad extension and concrete pad for flow meter in accordance with the contract plans and specifications.	113	SY		
15	See Drawings	**Chloramination Enclosure Building**. Furnish all materials, labor, and equipment to install concrete masonry unit including foundation, roof, doors, HVAC, and all appurtenances shown in the plans all in accordance with contract plans and specifications.	1	LS		
16	02610	**16-inch Ductile Iron Piping.** Furnish all materials, labor, equipment, and appurtenances to install new 16-inch ductile piping in accordance with contract plans and specifications.	110	LF		
17	02611	**16-inch Stainless Steel Piping.** Furnish all materials, labor, equipment, and appurtenances to install new 16-inch stainless steel piping in accordance with contract plans and specifications.	140	LF		
18	02670	**16-inch Double Check Valve.** Furnish all materials, labor, equipment, and appurtenances to install new 16-inch double check valves in accordance with contract plans and specifications.	1	EA		
19	02640	**16-inch Gate Valve**. Furnish all materials, labor, equipment, and appurtenances to install new 16-inch gate valves in accordance with contract plans and specifications.	3	EA		
20	11296	**Altitude Valve Assembly Rehabilitation (Cla-Val 131 Pilot System)**. Furnish all materials, labor, and equipment to rehabilitate the existing altitude valve assembly including installation of a new pilot system, diaphragm, gaskets, nuts, and bolts, all in accordance with contract plans and specifications.	1	LS		

Item No.	Spec No.	Item Description	Bid Qty.	Unit	Unit Price	Bid Amount
21	02685	**Flow Meter**. Furnish all materials, labor, and equipment to install a new electromagnetic flow meter in accordance with contract plans and specifications.	1	EA		
22	02050	**Fire Hydrant Assembly.** Furnish all materials, labor, and equipment to remove and dispose fire hydrant assembly in accordance with contract plans and specifications.	1	EA		
23	02664	**Water Service Connection with RPZ.** Furnish all materials, labor, and equipment to install water service connection with RPZ in accordance with contract plans and specifications.	1	LS		
24	11262	**Chloramine Disinfection Dosing System.** Furnish all materials, labor, equipment, and appurtenances to install a new chloramine disinfection dosing system including tanks, pumps, feeder, injectors, scales, monitoring equipment, shutoff valve, control panel, eyewash station, misc. pipes and fittings, all in accordance with contract plans and specifications.	1	LS		
25	11263	**LAS Disinfection Dosing System.** Furnish all materials, labor, equipment, and appurtenances to install a new LAS disinfection dosing system including tanks, pumps, feeder, injectors, monitoring, control, pipes and fittings, all in accordance with contract plans and specifications.	1	LS		
26	11261	**Tank Chloramine Anaylzer System.** Furnish all materials, labor, equipment, and appurtenances to install a new chloramine analyzer system, including relocating existing chemical analyzers from pedestal to chloramination enclosure building, in accordance with contract plans and specifications.	1	LS		
27	11250	**Tank Mixing System: Passive.** Furnish all materials, labor, equipment, and appurtenances to install a new passive tank mixing system in accordance with contract plans and specifications.	1	LS		
28	05500	**Steel Cable Bracing.** Furnish all materials, labor, and equipment to remove existing damaged steel cable bracing, and install new steel cable bracing, all in accordance with contract plans and specifications.	300	LF		
29	05500	**Pedestal Wall Penetration.** Furnish all materials, labor, and equipment to plug pedestal wall penetration in accordance with contract plans and specifications.	1	LS		
30	05500	**Exterior Vent and Handrails.** Furnish all materials, labor, and equipment to remove and replace all roof vent neck fasteners with stainless-steel bolts, nuts, and washers and 42" aluminum hand rails, all in accordance with contract plans and specifications.	1	LS		

Item No.	Spec No.	Item Description	Bid Qty.	Unit	Unit Price	Bid Amount
31	16211	**Electrical and Power Supply**. Furnish all materials, labor, and equipment to install terminal pole and service connection to power utility provider. All in accordance with contract plans and specifications.	1	LS		
32	16020	**Electrical Demolition**. Furnish all materials, labor, and equipment to perform electrical demolition all in accordance with contract plans and specifications.	1	LS		
33	16020	**SCADA Relocation.** Furnish all materials, labor, and equipment to remove and relocate the existing SCADA panel from the dry riser to the new chloramine dosing building, including all conduits, connections, switches, and lights, all in accordance with contract plans and specifications.	1	LS		
34	16950	**SCADA Upgrades**. Furnish all materials, labor, and equipment to install upgraded SCADA system and related sensors all in accordance with contract plans and specifications.	1	LS		
35	08999	**Tank Level System**. Furnish all materials, labor, and equipment to install a new tank level system including sensors, conduits, and cables, in accordance with contract plans and specifications.	1	LS		
36	16020	**DFS Antenna Removal.** Furnish all materials, labor, and equipment to remove the existing DFS antenna in accordance with the contract plans and specifications.	1	LS		
37	16510	**Bowl Lighting (LED).** Furnish all materials, labor, and equipment to remove the existing bowl illumination system and install new LED lighting, including all conduits, conductors, and connections to the existing lighting panel, all in accordance with contract plans and specifications.	1	LS		
38	16510	**FAA Lighting.** Furnish all materials, labor, and equipment to remove and replace the existing FAA lighting including all conduits and conductors and connections in the existing lighting panel, all in accordance with the contract plans and specifications.	1	LS		
39	09871	**Interior Coating System A (zinc primer, 2-coat epoxy).** Furnish all materials, labor, and equipment, to blast and recoat all interior (zinc primer, 2-coat epoxy) including pressure washing, shrouding, surface preparation, disinfection, providing and installing "Confined Space Entry" placecards, all in accordance with contract plans and specifications.	1	LS		

Item No.	Spec No.	Item Description	Bid Qty.	Unit	Unit Price	Bid Amount
40	09871	**Exterior Coating System C (zinc primer, 3-coat epoxy)**. Furnish all materials, labor, and equipment, to blast and recoat all exterior (zinc primer, 3-coat epoxy) including pressure washing, shrouding, surface preparation, all in accordance with contract plans and specifications.	1	LS		
					SUB-TOTAL BASE UNIT	
PART B - BASE UNIT PRICE TABLE - CONTINGENCY ALLOWANCE						
41	-	Project Contingency to be used at the Owner's discretion.	1	LS		
					SUB-TOTAL BASE UNIT - CONTINGENCY ALLOWANCE	
PART C - BID ALTERNATE 1 (REPLACES ITEMS 39 & 40)						
Item No.	**Spec No.**	**Item Description**	**Bid Qty.**	**Unit**	**Unit Price**	**Bid Amount**
39A	09871	**Interior Coating System B (zinc primer, 3-coat epoxy)**. Furnish all materials, labor, and equipment, to blast and recoat all interior (zinc primer, 3-coat epoxy) including pressure washing, shrouding, surface preparation, disinfection, providing and installing "Confined Space Entry" placecards, all in accordance with contract plans and specifications.	1	LS		
40A	09871	**Exterior Coating System D (zinc primer, Epoxy, Siloxane)**. Furnish all materials, labor, and equipment, to blast and recoat all exterior (zinc primer, epoxy, siloxane) including pressure washing, shrouding, surface preparation, all in accordance with contract plans and specifications.	1	LS		
					SUB-TOTAL BID ALTERNATE 1 ITEMS	

CITY OF GALVESTON, TEXAS

UTMB EST Rehabilitation

PROPOSAL FORM

Item No.	Spec No.	Item Description	Bid Qty.	Unit	Unit Price	Bid Amount
PART D - SUPPLEMENTAL ITEMS						
42	09871	**Tank Logo.** Furnish all materials, labor, equipment, and superintendence to replace UTMB Logo and City of Galveston Logo, in accordance with contract plans and specifications.	1	LS		
43	08999	**Structural Steel Spot Repairs.** Furnish all materials, labor, equipment, and appurtenances for "extra structural members, and all supporting structures, all shapes, all sizes, including removal and disposal of old members" all in accordance with contract plans and specifications.	100	LBS		
44	11296	**Altitude Valve Assembly Replacement (Cla-Val 610).** Furnish all materials, labor, and equipment to remove the existing altitude valve assembly and install a new altitude valve assembly in accordance with contract plans and specifications.	1	LS		
					SUB-TOTAL BID SUPPLEMENTAL ITEMS	

SUMMARY

PART A - SUB-TOTAL BASE UNIT _____

PART B - SUB-TOTAL BASE UNIT - CONTINGENCY ALLOWANCE _____

TOTAL BASE BID (PART A + PART B) _____

PART C - SUB-TOTAL BID ALTERNATE 1 ITEMS _____

PART D - SUB-TOTAL BID ALTERNATE 1 - CONTINGENCY ALLOWANCE _____

TOTAL BID ALTERNATE 1 (PART A + PART B+ PART C) _____

TOTAL BID (PART A + PART B + PART C + PART D) _____

*Note: If quantities exceed those listed, the additional quantities shall not exceed the unit prices listed herein.

COMPANY NAME (PRINTED): _____

NAME OF SIGNATORY (PRINTED): _____

SIGNATURE: _____

DATE: _____

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:

UTMB EST REHABILITATION

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 _____2025.

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

APPROVED AS TO FORM:

_____
Office of the City Attorney

NOTE: Attach Power of Attorney

"General Decision Number: TX20250062 03/07/2025

Superseded General Decision Number: TX20240062

State: Texas

Construction Type: Heavy

County: Galveston County in Texas.

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

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $17.75 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 2025.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2025
1	03/07/2025

* SFTX0669-001 01/01/2025

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers)	$ 36.15	24.47

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* 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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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 ($17.75) or 13658 ($13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

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

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) (iii)).

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

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate 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. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates
in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the 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. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

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

a) a survey underlying a wage determination

b) an existing published wage determination
c) an initial WHD letter setting forth a position on
a wage determination matter
d) an initial conformance (additional classification
and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

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

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail 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 an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail 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 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.

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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. **OWNER'S REPRESENTATIVE'S AUTHORITY AND DUTY:** **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. <u>DEFECTS AND THEIR REMEDIES:</u> 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. <u>CHANGES AND ALTERATIONS:</u> 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. <u>CHANGES IN THE WORK AND ADJUSTMENT OF CONTRACT PRICE:</u>

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. <u>INDEMNIFICATION; PROTECTION AGAINST ACCIDENT TO EMPLOYEES AND PUBLIC:</u> 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.

<u>INDEMNITY CLAUSE</u>: 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.

60. <u>ACCESS TO RECORDS:</u> The City of Galveston, or any of their authorized representatives, shall have access to any documents, papers, or other records of the Contractor which are pertinent to the contract award, in order to make audits, examinations, excerpts, and transcripts, and to closeout the contract.

61. <u>RETENTION OF RECORDS:</u> The Contractor shall retain all required records for three (3) years after the City makes its final payment and all pending matters are closed.

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 DATA 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. GENERAL PREVAILING WAGE RATES: 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. COMPLIANCE WITH AIR AND WATER ACTS:

(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. EQUAL EMPLOYMENT OPPORTUNITY

(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. THE PROVISION OF LOCAL TRAINING, EMPLOYMENT, AND BUSINESS OPPORTUNITIES:

(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. NON SEGREGATED FACILITIES: 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. JOB OFFICES:

(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.

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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.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. Work of the contract is for the rehabilitation of the 1.0 million gallon multi-leg elevated storage tank located at the corner of Harborside Dr. and North Holiday Dr, site improvements, and installation of a chloramine booster station. Work includes:

1. Demolition and removal of SCADA antenna and portions of the CMU wall, as indicated on the plans.

2. Blasting and recoating of the exterior and interior of the EST, including installation and removal of a containment shroud.

3. Structural and spot repair of steel.

4. Repair and reattachment of cable ties on the tank pedestal legs.

5. Installation of a dedicated 16” steel water line, valves, fittings, and appurtenances to fill the tank and installation of Tide-flex mixing valves.

6. Installation of a water service connection with RPZ.

7. Installation of a 11.3-foot by 18-foot concrete masonry unit (CMU) including lighting, ventilation, doors, and waterproofing membrane.

8. Installation of chloramine disinfection dosing system including analyzers, dosing units, booster pumps, chemical injectors, valves, piping, and appurtenances, and personal protection equipment required by TCEQ.

9. Removal and replacement of safety railings and 24” gooseneck vent

10. Rehabilitation of a 16-inch altitude control valve, installation of flow meter, gate valves, check valves, yard piping, and pipe thrust blocks.

11. Electrical: Power delivery for chloramine dosing system and analyzers, dosing pumps, relocation of SCADA equipment, removal of existing DFS antenna,

installation of LED bowl lighting, and installation of Federal Aviation Administration (FAA) lighting on top of the tank.

12. Installation of driveway and bollards. Removal of curb and sidewalk.

13. Installation of brick capstones as shown on plans.

14. Chain link fence removal and replacement and installation of a cantilever sliding gate.

15. Traffic control plan implementation.

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 Alternates:

1. Alternate No. 1: Interior Coating System B. Installation of a zinc primer and a three (3) - coat epoxy to the interior of the elevated storage tank.

2. Alternate No. 2: Exterior Coating System D. Installation of a zinc primer, epoxy layer, and siloxane top coat to the exterior of the elevated storage tank.

1.04 WORK BY OWNER - NOT USED

1.05 OWNER FURNISHED PRODUCTS - NOT USED

1.06 WORK SEQUENCE

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. Construct Work in phases as outlined

below. During the construction period, coordinate construction schedule and operations with Owner's Representative:

1. Phase 1: Bring tank out of service and implement traffic control measures. Installation containment shroud, tank blasting, steel spot repair, structural repairs, and interior/exterior coatings. Remove shroud.

2. Phase 2: Install concrete pads, complete mechanical piping work on site and install chlorine dosing and LAS, electrical work

3. Phase 3: Complete remainder of site work including fence, gate, installation of lighting fixtures. Perform clean-up and restoration, punch-list and closeout items.

1.07 FUTURE WORK - NOT USED

1.08 UTILITY OUTAGE AND SHUTDOWN

A. Coordinate with the City of Galveston Engineering/Public Works for tank shutdown prior to commencing construction and tank re-fill once construction is complete. Contractor is made aware the tank will be out of service until work has been tested and accepted by the City.

B. Electrical service on site shall not be interrupted during construction. Contractor shall coordinate with CenterPoint Energy as necessary to facilitate any changes in power delivery to the site.

1.09 OWNER OCCUPANCY – NOT USED

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 GENERAL

1.01 SECTION INCLUDES

A. General use of the site including properties inside and outside of rights-of-way, work affecting roads, 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 the City as stipulated in the General Conditions of the Agreement and identified in the Plans; trespassing on abutting lands or other lands in the area is not allowed.

B. Make arrangements, at no cost to the City, for temporary use of private properties. Contractor and Surety shall indemnify and hold harmless the City against claims or demands arising from such use of properties outside the rights-of-way. Submit a copy of agreements between private property owners and Contractor prior to use of the area. Agreements between private property owners and Contractor shall be notarized or bear the signatures of two (2) witnesses.

C. Obtain written permission from the City for storage of materials on esplanades and other areas within rights-of-way. Written permission must be obtained prior to use of the area.

D. Restrict total length of distributed materials along the route of construction to 1,000 linear feet unless otherwise approved in writing by the City.

E. Restrict all demolition, construction, and testing activities to two (2) lanes in one direction to a total length of 1,000 linear feet or three (3) City blocks, whichever is less. All work within the restricted limits shall be completed in its entirety, including access to driveways, sidewalks, ADA ramps, etc., prior to proceeding to the next section.

1.03 PROPERTIES OUTSIDE THE RIGHTS-OF-WAY

A. Do not alter the condition of property adjacent to and along rights-of-way.

B. Do not use ways, means, methods, techniques, sequences, or procedures that result in damage to properties or improvements.

C. Restore damaged properties outside of rights-of-way to the satisfaction of the City and property owner at no cost to the City or property owner.

D. Provide written verification from the affected property owner(s) certifying that all restoration work has been completed to their satisfaction.

1.04 USE OF SITE

A. Impeding or closing of public roads and streets shall not be permitted without prior written approvals from governing authorities. Closure of more than two (2) consecutive intersections at one time will only be permitted under special circumstances approved by the City.

B. Requests for closure of public roads or streets shall be submitted to the City a minimum of three (3) working days prior to the need for a partial closure, and five (5) working days prior to the need for a full closure. Requests shall include a detour map.

C. Maintain 10-foot-wide minimum access lane 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.

G. Beware of overhead power lines existing in area and in proximity of the Project. When 10-feet of clearance between energized overhead power line and construction- related activity cannot be maintained, request Center Point Energy (CPE) de-energize or move conflicting overhead power line. Contact CPE representatives at (713) 207-2222. Schedule, coordinate and pay costs associated with de-energizing or moving conflicting overhead power lines. When there is no separate pay item for this effort, include these costs in various items of bid that make such work necessary.

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 two (2) weeks prior to work performed within 200 feet of homes or businesses.

B. Include in notification the nature of the Work, and 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 City 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 The City.

D. In regard to notifications on all water lines work affecting water service, the Contractor must perform all customer notifications and complete a Notice of Customer Communication form provided by the Project Manager that such notice has been given 48-hours in advance of any water disruptions. Notification must also include the approximate duration of planned service outages. The City Inspector must have the completed Notification of Customer Communication form before the commencement of valve assisted work. Follow the form and content of sample door hanger provided by the City.

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 City.

B. Obtain the City'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 City.

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 TRAFFIC CONTROL

A. Comply with traffic regulation as specified in Section 01570 - Traffic Control and Regulation.

1.09 SURFACE RESTORATION

A. Restore site including landscaping to the condition existing before construction or better to the satisfaction of the City.

B. Repair paved areas per the requirements of Sections 02225, 02226, 02227, 02570, and 02571, as applicable and any additional requirements included in the plans.

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

1.10 LIMITS OF CONSTRUCTION

A. Confine operations to lands within construction work limits shown on Drawings. Unless otherwise noted on Drawings adhere to the following:

1. Where utility alignment is within esplanade, and construction limits are shown on Drawings to extend to edge of esplanade, keep equipment, materials, stockpiles a minimum of five feet from back of curb.

2. Where construction limits shown on Drawings extend to property line, keep sidewalks free of equipment, materials, and stockpiles.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

SECTION 01020
ALLOWANCES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall include in his proposal the allowances stated in this and following Sections of the Project Manual. Allowance may pertain to purchase and delivery only, or to purchase, delivery, and installation, or to services only, or to contingency fund.

B. If the allowance is stated for purchase and delivery only, all of the Contractor's handling costs on site, overhead, profit, and other expenses contemplated for the allowance material and equipment shall be included in the base proposal.

C. If the allowance is stated for purchase, delivery, and installation, all of the Contractor's handling costs on site, overhead, profit, and other expenses contemplated for the allowance material and equipment shall be included in the allowance.

D. If the allowance is stated for services only, all of the Contractor's handling costs on site, overhead, profit, and other expenses contemplated for the services shall be included in the allowance.

E. If the allowance is stated for contingency, all of the Contractor's handling costs on site, overhead, profit, and other expenses contemplated for the allowance material and equipment shall be included in the allowance.

F. The Contractor shall purchase the allowance materials and equipment as directed by the Engineer/Architect in writing. The Engineer/Architect will have obtained the necessary forms and signatures to accomplish this. If the actual cost of the required work is more or less than all the allowance estimates, the Contract Sum will be adjusted accordingly by Change Order.

G. The Engineer/Architect cannot certify applications for payment of any allowance item unless a fully executed Allowance Authorization is on file with the Owner, Engineer/Architect, and Contractor.

1.2 CONDITIONS

A. Unexpended balance of allowance sums shall revert to the Owner in the final settlement of the Contract.

PART 2 - ALLOWANCES

2.1 ITEMS

A. Contingency:..... 10% of base bid and any alternates listed separately. Contractor shall include in the Base Proposal the sum listed as a contingency to cover the cost of "Items not shown on the Contract Documents". Contractor shall proceed with the work in question only after receiving written directions executed by the Owner and the Engineer/Architect. Owner will not be obligated to pay the cost of any work performed without prior written authorization. The Contractor's overhead and profit relative to this contingency allowance sum and work performed in accordance herewith, shall be included in the contingency allowance sum.

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 01292

SCHEDULE OF VALUES

PART 1 GENERAL

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 to be used as the basis for preparing applications for payment.

1.02 PREPARATION

A. For Stipulated Price Contracts, subdivide the Schedule of Values into logical portions of the Work, such as major items or work in contiguous construction areas. Use Section 01310 – Construction Schedule as a guide to subdivision of work items. Directly correlate Items in the Schedule of Values with tasks in the Construction Schedule. Organize each portion using the Project Manual Table of Contents 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, the order and general description of the original bid items shall be used to format the Schedule of Values including quantities and unit prices. A proportional share of the Contractor's overhead and profit shall be included in each item so that the total of all items will equal the Contract Price.

C. For lump sum equipment items, where submittal of operation and maintenance data and testing are required, include separate items for equipment operations and maintenance data where:

1. Submittal of maintenance data is valued at five (5) percent of the lump sum amount for each equipment item, and

2. Submittal for testing and adjusting is valued at five (5) percent of the lump sum amount for each equipment item.

Round off figures for each listed item to the nearest $100. Set the value of one (1) item, when necessary, to make the total of all values equal the Contract Price for Stipulated Price Contracts or the lump sum amount for Unit Price Work.

1.03 SUBMITTAL

A. Submit the Schedule of Values in accordance with the requirements of Section 01300 – Submittals. Submit initial Schedule of Values within 15 days of contract execution.

B. Submit the Schedule of Values in an approved electronic spreadsheet file and 8 ½ x 11-inch PDF.

C. Revise the Schedule of Values for items affected by Contract Modifications. After the City has reviewed the changes, resubmit at least ten (10) days prior to the next scheduled application for progress payment.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – 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 GENERAL

1.01 SECTION INCLUDES

A. Provide Construction Schedules for the Work included in this Contract in accordance with requirements in this Section. Create Construction Schedule using Critical Path Method (CPM) computer software. Prepare by bar chart method with activity listings arranged in chronological order by beginning of each item of work.

B. Provide monthly Construction Schedule Update and Narrative Schedule Report submittal in accordance with the requirements of this Section.

1.02 SUBMITTALS

A. Confirm to the requirements of Section 01300 – Submittals.

B. Provide sample Construction Schedule at the Pre-Construction conference and proposed scheduling software for review and discussion.

C. Submit initial schedules within fifteen days after execution of Contract or the Pre-Construction conference, whichever is later. Project Manager will review schedules and return review copy within seven (7) days of submittal.

D. If required, resubmit within seven (7) days after return of review copy.

E. Construction Schedule shall include the following content:

1. Complete sequence of construction by activity:

a. Shop drawings, product data and samples: Submittal dates and dates reviewed copies will be required.

b. Decision dates.

c. Product procurement and delivery dates.

d. Dates for beginning, and completion of each element of construction.

e. Tentative dates for progress meetings.

f. In accordance with Section 01015 – Contractor’s Use of Premises, 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. All

work within the restricted limits shall be completed in its entirety, including access to driveways, sidewalks, ADA ramps, etc. prior to proceeding to the next section.

2. Show projected percentage of completion for each item of work as of first day of each month.

3. Furnish sub schedules to define critical portions of entire schedule.

4. Show anticipated payment to complete work.

5. Anticipated Substantial and Final Completion Dates and one-year post acceptance inspection date.

1.03 CONSTRUCTION SCHEDULE UPDATE AND NARRATIVE SCHEDULE REPORT

A. Provide Construction Schedule Update submittal including Narrative Schedule Report at the beginning of each month.

B. Construction Schedule Update shall indicate progress of each activity and any changes to completion dates.

C. Narrative schedule report shall list activities started this month, activities completed this month, activities continued this month, activities scheduled to start or complete next month, problems encountered this month, and actions taken to solve these problems.

D. Narrative schedule report shall describe changes made to Construction Schedule logic (i.e. changes in predecessors and lags), activities added to schedule, activities deleted from schedule, any other changes made to the schedule other than addition of actual start dates and actual finish dates and changes of data date and remaining durations for recalculation of mathematical analysis.

E. Project Manager will review Construction Schedule Update and Narrative Schedule Report and return review copy within seven (7) days of submittal.

F. If required, resubmit within seven (7) days after return of review copy.

G. Failure to submit Construction Schedule Update and Narrative Schedule Report in accordance with the requirements of this section will result in the Contractor's request for payment to be held until furnished.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – 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

1.1 SECTION INCLUDES

A. Quality assurance and control of installation and manufacturer's field services and reports.

1.2 SUBMITTALS

A. Make Submittals required by this section and in accordance with all provisions of these specifications.

1.3 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.

1.4 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 GENERAL

1.01 SECTION INCLUDES

A. Temporary facilities and necessary controls for the Project, including utilities, telephone, sanitary facilities, storage sheds and buildings, safety requirements, first aid equipment, fire protection, security measures, protection of the Work and property, access roads and parking, environmental controls, water runoff and erosion control (including all stormwater pollution prevention measures), pest and rodent control and disposal of trash, debris and excavated material.

B. Facilities and controls specified in this section are considered minimum for the Project. Provide additional facilities and controls for proper execution of the Work and to meet Contractor's responsibilities for protection of persons and property.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. No separate payment will be made for any temporary facilities and controls required under this section. Include cost of such work in contract price listed for mobilization.

1.03 CONTRACTOR'S RESPONSIBILITY

A. Comply with applicable requirements specified in other sections of Specifications.

1. Maintain and operate temporary facilities and systems to assure continuous service.

2. Modify and extend systems as the Work progress requires.

3. Completely remove temporary materials and equipment when no longer required.

4. Restore existing facilities used for temporary services to specified or original condition.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.01 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 Date of Substantial Completion. Included are fuel, power, light, heat, and other utility services necessary for execution, completion, testing, and initial operation of 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. Water to be drawn from public fire hydrants. Obtain temporary meter from City of Galveston and pay required deposit based on rates established by latest ordinance. Contractor shall operate fire hydrants only with an approved hydrant wrench.

3. Provide and maintain an adequate supply of potable water for domestic consumption by Contractor personnel, Project Manager and representatives of the City.

C. Electricity and Lighting

1. Provide electric power service required for the Work including required testing, lighting, operation of equipment, and other Contractor use.

2. Electric power service includes temporary power or generators required to maintain plant operations during scheduled shutdowns.

3. Minimum lighting level shall be 10 foot-candles for open areas; 20-foot- candles for stairs and shops. Provide a minimum of one 300-watt lamp for each 200 square feet of work area.

D. Temporary Heat and Ventilation:

1. Provide temporary heat 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 degrees F.

E. Telephone:

1. Provide emergency telephone service at Project site 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 site; comply with regulations of State and local departments of health.

2. Enforce use of sanitary facilities by construction personnel at site. Enclose sanitary facilities. Pit-type toilets are not permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause nuisance or health problems. Haul sewage and waste off-site and properly dispose in accordance with applicable 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.

3.02 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 City.

3.03 LAYDOWN YARD

A. All contractors are required to secure and maintain a laydown yard for storage of materials and equipment for the term of the Project.

1. For all projects in City ROW, contractor shall obtain a suitable laydown yard for storage of materials and equipment for the term of the Project. ROW and esplanades shall not be used without prior written consent from the City of Galveston. Lease agreements shall be submitted for the project files.

2. For facility projects where the site size does not permit storage of materials and equipment, contractor shall obtain a suitable laydown yard for the term of the project. Lease agreements shall be submitted for the project files.

3. Contractor shall be permitted to store materials and equipment in designated areas identified on the plans for facility projects where the site size permits storage of materials and equipment.

B. All materials stored in approved laydown yard(s) shall be enclosed with temporary fencing. See Section 3.04 for additional materials storage requirements.

C. Upon completion of the Project, contractor shall obtain and submit a written release from the laydown yard property owner certifying the lot has been restored to its original condition or better in accordance with the General Conditions of the Contract.

3.04 STORAGE OF MATERIALS

A. Provide adequately ventilated, watertight storage facilities with floor above ground level for Products susceptible to weather damage.

B. Storage of Products not susceptible to weather damage may be on blocks off the ground.

C. Store Products in a neat and orderly manner. Place Products to permit easy access for identification, inspection and inventory.

D. Fill and grade site for temporary structures to provide drainage away from temporary and existing buildings.

E. Contractor is responsible for materials and equipment stored on and off site.

3.05 SAFETY REQUIREMENTS

A. Submit a safety program at the Pre-construction Conference to be followed for the duration of the Project. Include 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. Observe 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 Project Manager. Immediately advise the Project Manager 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 Project Manager of the results. Submit one copy of accident reports to Project Manager within ten (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 evidence of contamination, and immediately 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 City 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.

3.06 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.

3.07 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 3,000 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.

3.08 SECURITY MEASURES

A. Protect the Work, materials, equipment, and property from loss, theft, damage, or vandalism. Protect City property used in performance of the Contract.

B. If existing fencing or barriers are breached or removed for purposes of construction. Provide and maintain temporary security fencing equal to existing.

3.09 PROTECTION OF UTILITIES AND PIPELINES

A. Prevent damage to existing public utilities during construction. Approximate locations of known utilities are shown on Drawings, but all lines may not be shown. Excavate with caution and repair lines damaged by construction operations.

B. Use the Utility Coordinating Committee One Call System, telephone number, (713) 223-4567, which must be called 48 hours in advance. The toll free telephone number is 1-800-669-8344, Texas One Call System.

C. Before excavating, locate underground utilities by appropriate means including the use of metal detection equipment, and probes, or by excavation or surveys. Repair damage caused by investigative work and by failure to locate or to preserve underground utilities.

D. Give utility owners a minimum five (5) days' notice before commencing excavation to allow time to locate utilities and make adjustments or relocations when they conflict with the Work. Include cost for temporary relocation of water, wastewater, and storm drainage lines, necessary to accommodate construction, in unit prices for utility construction unless otherwise noted. Bypassing of sanitary waste to storm drainage facilities is not allowed.

E. Prior to excavation near pipelines, request a representative of the pipeline company to meet with Contractor and Project Manager at the site to discuss procedures to be used. Request pipeline company's representative to locate the pipelines in at least three locations: at each side and at centerline of proposed excavation of proposed utility. Also request representative and Project Manager to be present to observe Contractor operations when excavation is conducted within 15 feet of pipeline.

F. Utility service lines are not typically shown on the Drawings. Contractor should anticipate that such service lines exist and repair them immediately if damaged due to any construction activity. No separate pay for repair of utility service lines. Include payment in unit price for work in appropriate sections.

G. 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.

3.10 PROTECTION OF THE WORK AND PROPERTY

A. Preventive Actions

1. Take necessary precautions and actions to prevent damage, injury, or loss to the Work or public and private property, including:

a. Storage of apparatus, supplies, and Products in an orderly, safe manner to limit interference with progress of the Work or work of other contractors, utility service companies, or the City's operations.

b. Suitable storage for Products subject to damage by exposure to weather, theft, breakage, etc.

c. Limitation of loading pressures imposed upon portions of the Work.

d. Frequent clean up of refuse, scrap materials, and debris from construction operations, necessary to maintain the site in a safe and orderly condition.

e. Provision of barricades and guard rails to protect pedestrian and traffic around openings, scaffolding, temporary stairs and ramps, excavations, elevated walkways, and other hazardous areas.

2. Protect public and private property adjacent to the site. Obtain written consent before entering or occupying privately-owned land exception easements provided for construction. Restore property damaged by construction operations to condition equal to or better than that existing before the damage.

B. Barricades and Warning Systems

1. Where work is performed on or adjacent to roadways, rights-of-ways, or public land, provide barricades, fences, lights, warning signs, danger signals, and other precautionary measures necessary for protection of persons or property and for protection of the Work.

a. Erect sufficient barricades to keep vehicles and pedestrians from entering the Work. Paint barricades to be visible at night. From sunset to sunrise, provide at least one light at each barricade.

b. Maintain barricades, signs, lights, and provide watchmen until Project Manager approves removal. Whenever work creates encroachment onto public roadways, station flagmen to manage traffic flow in accordance with approved traffic control plan.

c. Conform to requirements of Section 01570 – Traffic Control and regulation.

C. Tree and Plant Protection

1. Comply with requirements of Section 01535 – Tree and Plant Protection.

D. Protection of Existing Structures

1. Underground Facilities

a. Known Underground Facilities are shown on the Drawings but all Facilities may not be shown. Explore sufficiently ahead of trenching and excavation work to locate Underground Facilities in order to prevent damage to them and to prevent interruption of utility services. Restore

damage to Underground Facilities to original condition at no additional cost to the City.

b. If necessary to avoid unanticipated Underground Facilities, Project Manager may make changes in location of the Work.

c. If permanent relocation of an Underground Facility is required and not provided for in the Contract documents, City Engineer or Project Manager will direct Contractor in writing to perform the Work under Modification provisions in the General Conditions of the Agreement.

2. Surface Structures include 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 level.

3. Protection of Underground Facilities and Surface Structures:

a. Support in place and protect Underground Facilities and Surface Structures located within or adjacent to the limits of the Work from damage. Install supports as required by the owner of the structure. Satisfy Project Manager that the owner of the facility or structure has approved methods and procedures before installing structure supports.

b. Avoid moving or changing public utility or private corporation property without prior written consent of a responsible official of the facility or structure. Allow representatives of utilities to enter the construction site for maintenance and repair purposes or to make necessary changes.

c. Notify utility and pipeline owners and operators of the nature of construction operations and dates when operations will be performed. When construction operations are required in immediate vicinity of existing structures, pipelines, or utilities, give a minimum of five (5) working days advance notice. Probe and flag location of Underground Facilities prior to commencement of excavation. Keep flags in place until construction operations uncover the facility.

d. Assume risk for damages and expenses to Underground Facilities and Surface Structures within or adjacent to the Work.

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 the Work.

2. Control traffic to prevent damage to Products and surfaces.

3. Provide coverings to protect Products from damage. Cover projections, wall corners, jambs, sills, and exposed sides of openings in areas used for traffic and passage of materials in subsequent work.

3.11 ROADS AND PARKING

A. Prevent interference with traffic and operations of the City on existing roads.

B. Designate temporary parking areas to accommodate construction and City personnel. When site space is not adequate, provide additional off-site parking. Locate as approved by Project Manager.

C. Minimize use by construction traffic on existing streets and driveways.

D. Do not allow heavy vehicles or construction equipment in existing parking areas.

3.12 ENVIRONMENTAL CONTROLS

A. Use methods, equipment, and temporary construction necessary for control of environmental conditions at the site and adjacent areas.

B. Comply with statutes, regulations, and ordinances relating to prevention of environmental pollution and preservation of natural resources including National Environmental Policy Act of 1969, PL 91-190, Executive Order 11514.

C. Minimize impact to the surrounding environment. Do not use construction procedures that cause unnecessary excavation and filling of terrain, indiscriminate destruction of vegetation, air or stream pollution, or harassment or destruction of wildlife.

D. Limit disturbed areas to boundaries established by the Contract. Do not pollute on-site streams, sewers, wells, or other water sources.

E. Do not burn rubbish, debris or waste materials.

3.13 POLLUTION CONTROL

A. Provide methods, means, and facilities necessary to prevent contamination of soil, water or the atmosphere by discharge of Pollutants from construction operations.

B. Provide equipment and personnel to perform emergency measures to contain spillage, and to remove contaminated soils or liquids. Excavate and dispose of contaminated earth off-site in accordance with laws and regulations, and replace with suitable compacted fill and topsoil.

C. Provide systems necessary for control of Pollutants.

1. Prevent toxic concentrations of chemicals.

2. Prevent harmful dispersal of Pollutants into the environment.

D. Use equipment that conforms to current Federal, State, and local laws and regulations.

3.14 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 that will not adversely affect conditions at site or on adjoining properties.

3.15 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 Project Manager.

C. Select construction equipment that operates with minimum noise and vibration. When directed by Project Manager, correct objectionable noise or vibration produced by operation of equipment at no additional cost to the City. Sound Power Level (PWL) of equipment shall not exceed 85 dbA (re: 10-12 watts) measured five feet from the equipment, or at a lower level if prescribed by City Ordinances. Equipment noise requirements are contained in equipment specifications.

3.16 DUST CONTROL

A. Use water or other methods approved by Project Manager to control amount of dust generated by vehicle and equipment operations.

3.17 WATER RUNOFF AND EROSION CONTROL

A. Comply with requirements of section 01410 – TPDES Requirements.

B. Conduct fill, grading and ditching operations and provide adequate methods necessary to control surface water, runoff, subsurface water, and water from excavations and structures in order to prevent damage to the Work, the site, or adjoining properties.

1. Plan and execute construction and earthwork by methods that control surface drainage from cuts and fills, and from borrow and waste disposal areas.

2. Minimize area of bare soil exposed at one time.

3. Provide temporary control measures, such as berms, dikes, and drains.

4. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

5. Construct fill and waste areas by selective placement of materials to eliminate erosion of surface silts or clays that may erode.

6. Direct water away from excavations, pits, tunnels, and other construction areas to prevent erosion, sedimentation or damage.

7. Maintain existing drainage patterns adjacent to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover.

8. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to the site or adjoining areas, in conformance with environmental requirements.

9. Inspect earthwork periodically to detect any evidence of erosion. Take corrective measures as required to control erosion.

END OF SECTION

SECTION 01505

MOBILIZATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mobilization of construction equipment and facilities onto the site.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts: If Contract is Unit Price Contract, measurement for mobilization is on a lump sum basis and shall not exceed three (3) percent of the base bid.

B. Stipulated Price (Lump Sum) Contract. If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

C. Mobilization payments may be included in monthly payment estimates upon written application by Contractor, subject to the following provisions:

1. Authorization for payment of 50 percent of the contract price for mobilization will be made upon receipt and approval by the City or Project Manager of the following items, as applicable:

a. Submittal Schedule (Specification Section 01300)

b. Schedule of Values (Specification Section 01292)

c. Traffic Control Plan, as applicable (Specification Section 01570)

d. Trench Safety Program (Specification Section 01526)

e. Construction Schedule (Specification Section 01310)

f. Construction Photographs (Specification Section 01380)

g. Building Permit (for Facility Projects)

h. Lease Agreement for Laydown Yard, as applicable (Specification Section 01500)

i. Mobilize construction equipment, facilities, and materials to the site or sites.

2. Authorization for payment of the remaining 50 percent of the mobilization will be made upon completion and acceptance of an additional 10% of the project and submittal of invoice reflecting this work to the City contingent on the following:

    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.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – 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

1.1 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.

1.2 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.

1.3 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.

1.4 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.

1.5 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.

1.6 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

2.1 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

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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

1.1 SECTION INCLUDES

A. Disposal of waste material and salvageable material.

1.2 UNIT PRICES

A. No separate payment will be made for waste or fill material disposal under this Section. Include payment in unit price for related work.

1.3 SUBMITTALS

A. Submittals shall conform to requirements of all Sections and provisions of these contract documents including Section 01300 - Submittals.

B. Obtain and submit to the City copies of disposal permits in accordance with TCEQ regulations (https://www.tceq.texas.gov/permitting/waste_permits/waste_mgt) for the proposed construction debris (asphalt, shingles, concrete, rebar, etc.) and clean fill material (sand, silt or clay) disposal sites. Disposed material placed as fill shall be approved in writing by the Owner and shall be in accordance with all local, state and federal requirements (see TCEQ Table attached to the end of this document). No fill shall be placed on any property/location in the City of Galveston without an approved fill permit from Development Services obtained by the property owner. The property owner is not allowed to receive any fill material other than sand, clay or silt (clean fill) from the construction site pre-approved under an issued Development Services Fill Permit (Municode Section 18-121 & 122 and Section 23-100 to 105). Sec. 23-106. - Penalties.

C. Any person who violates any provision of this article, or who fails to comply with an order issued by the director or head of any City department or the Construction Manager, shall be deemed guilty of a misdemeanor and upon conviction shall be subject to a fine in accordance with the city Code and applicable state laws.

D. 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.

E. Describe waste materials expected to be stored on-site and a description of controls to reduce Pollutants from these materials, including storage practices to minimize exposure of materials to storm water; and spill prevention and response measures in the Project's Storm Water Pollution Prevention Plan (SWPPP). Refer to Section 01565 -

TPDES Requirements.

F. If the contractor's operations at the construction project site is shut down by the City due to non-compliance with this and other related specifications, no schedule extensions will be provided by the City and Contractor cannot make or submit any claims to the City.

1.4 WASTE MANAGEMENT DEFINITIONS

Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

Commingling: Mixing recyclable C/D material in one waste container. Materials Recovery Facilities (MRF) exist to sort and recycle commingled materials off- site.

Construction and Demolition Waste: Includes all non-hazardous solid wastes resulting from construction, renovations, alterations, repair, and demolition.

Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitability, corrosiveness, toxicity or reactivity.

Material Recovery Facility (MRF): A processing facility designed to sort and separate recyclables based on market needs and material components.

Non-hazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitability, corrosiveness, toxicity, or reactivity.

Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste. Can be conducted on- site (as in the grinding of concrete and reuse on-site).

Return: To give back reusable items or unused products to vendors for credit.

Reuse: To reuse a construction waste material without altering its form on the Project site or elsewhere.

Salvage: To remove a waste material from the Project site to another site for resale or reuse by others.

Sediment: Soil and other debris that has been eroded and transported by storm or well

production runoff water.

Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste in order to reuse or recycle them.

Toxic: Poisonous to humans either immediately or after a period of exposure.

Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

Volatile Organic Compounds (VOCs): Chemical compounds common in and emitted by many building products over time through offgassing: solvents in paints and other coatings; wood preservatives; strippers and household cleaners; adhesives in particleboard, fiberboard, and some plywood; and foam insulation. When released, VOCs can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.

Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

Construction Site Waste Management Plan (CSWMP): A Project-related plan for the collection, transportation, and disposal of the waste generated at the construction site. Contractor shall submit a letter to the City detailing how he plans to handle fill and debris from the construction site prior to construction mobilization. Confirm to Section 01300 Submittals.

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 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 loading and delivery of salvageable material with Owner's

Representative.

3.2 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 at a TCEQ approved disposal site. Upon Owner's request, Contractor to provide disposal site Bill of material and Manifests signed by the operator of the receiving disposal facility to document compliance with TCEQ disposal regulations.

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 UNIT PRICES

A. No separate payment will be made for work performed under this Section.

1.03 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

TCEQ Office Use Only
Permit No.: TXR15
RN:
CN:
Ref No:

Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under TPDES General Permit (TXR150000)

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)

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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.

ATTACHMENT 1

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

ATTACHMENT 1

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

ATTACHMENT 1

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).

ATTACHMENT 1

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

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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

ATTACHMENT 5

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
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:	512/239-4671
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. No separate measurement and payment will be made for work performed under this Section. Include payment in lump sum price for related work.

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

1.01 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.

1.02 SUBMITTALS

A. Make submittals in accordance with Section 01300 - Submittals

1.03 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.

1.04 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

2.01 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

3.01 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.

3.02 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.

3.03 FLARES AND LIGHTS

A. Provide lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.04 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.

3.05 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.

3.06 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.

3.07 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.

3.08 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.

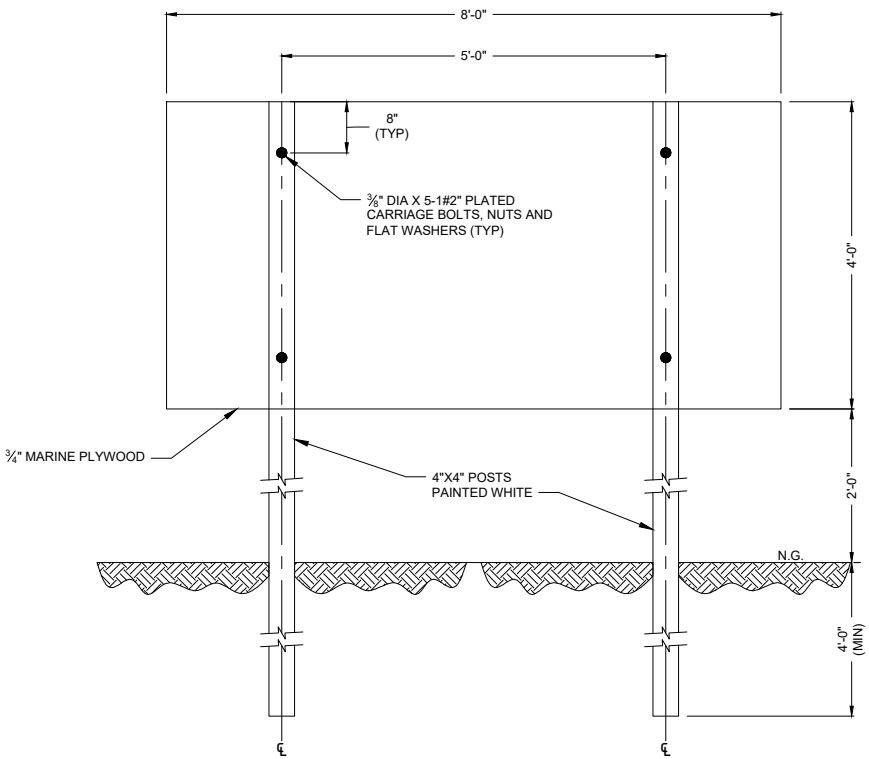
E. Erect sign so that the top edge of the sign is no higher than 6-feet above existing grade.

3.02 MAINTENANCE AND REMOVAL

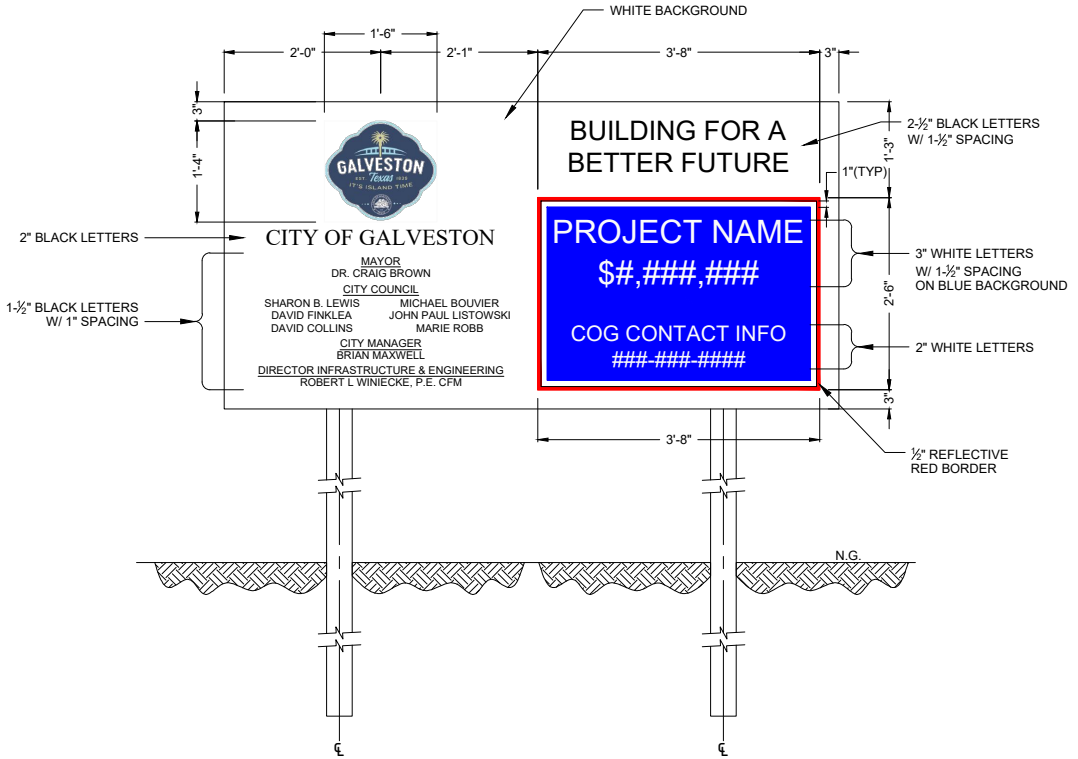
A. Keep signs and support clean. Repair deterioration and damage.

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



BACK VIEW
(N.T.S)



FRONT VIEW
(N.T.S.)

NOTES:

1. FOR PROJECTS OF GREATER THAN 12 MONTHS DURATION, 3" GALVANIZED HARDWARE METAL POSTS ARE REQUIRED.
2. CONTRACTOR SHALL MAINTAIN POST UNTIL COMPLETION OF PROJECT.

CITY OF GALVESTON
ENGINEERING DEPARTMENT
3015 MARKET ST. GALVESTON, TX 77553
409.797.3630

GENERAL
CONSTRUCTION DETAILS

PROJECT SIGN

APPROVED BY:

DIRECTOR OF INFRASTRUCTURE
& ENGINEERING

DWG NO.: 1580-01

DATE: NOV 2023

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 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 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 lead walk is on a square feet basis.

7. Measurement for removing and disposing of concrete driveway is on a square yard basis.

8. Measurement for removing and disposing of miscellaneous concrete and masonry items is on a cubic yard basis of the structure in place.

9. 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 02100

RIGHT OF WAY PREPARATION

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. Removal and replacement of fence section.

F. Temporary Fencing.

G. Excavation and fill.

H. Disposal of waste materials.

I. Disposal of excess materials.

J. Salvaging of designated items.

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 unless stated otherwise in the Bid Proposal.

B. Side streets and utility easements involving any work in this contract will not be measured separately and are considered incidental to the project.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Imported fill

1. Sand, gravel, earth or combination, which can be compacted to form stable embankments and fills conforming to select borrow standards:

a. Liquid limit: 45 maximum, ASTM D 4318.

b. Plasticity index: 12 minimum, 20 maximum, ASTM D 4318.

c. Free from trash, vegetation, organic matter, large stones, hard lumps of earth and frozen, corrosive or perishable material.

d. Well broken up, free of clods of hard earth, rocks, and stones greater than 2-inch dimension.

PART 3 E X E C U T I O N

3.01 PRESERVATION OF STAKING

A. Use caution to preserve survey staking, monuments and property corners.

B. Employ a Registered Public Surveyor to reset any missing, disturbed, or damaged monumentation.

3.02 SITE CLEARING

A. Protect trees and shrubs designated to remain in accordance with Section 01535 – Tree and Plant Protection.

B. Protect utilities to remain free from damage.

C. 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.

D. Topsoil Removal:

1. Remove grass from areas before stripping.

2. Topsoil is defined as surface soil found of depth of not less than 4 inches.

3. Strip topsoil to depths encountered.

4. Perform stripping in a manner to prevent intermingling of topsoil with underlying sterile subsoil and remove objectionable materials, including clay lumps, stones over 2 inches in diameter, weeds, roots, leave and debris.

5. Where trees are designated by Owner to be left standing, stop topsoil stripping at extreme limits of tree drip line to prevent damage to main root system.

6. Construct storage piles to freely drain surface water.

7. Cover storage piles, if required, to prevent wind-blown dust.

8. At completion, transport topsoil from stockpiles to work site for spreading and final fine grading.

E. Clearing and Grubbing.

1. Clear project site of trees, shrubs, and other vegetation, except for those designated by Owner to be left standing.

2. Completely remove stumps, roots, and other debris protruding through ground surface.

3. Use only hand methods for grubbing inside drip line of trees.

4. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

5. Place fill material in horizontal layers not exceeding 6 inches loose depth and thoroughly compact to density equal to adjacent original ground.

6. On areas required for roadway, channel, or structural excavation, remove stumps and roots to depth of 2 feet below lower elevation of excavation.

7. On areas required for embankment construction, remove stumps and roots to depth of 2 feet below ground surface.

8. Blade entire area to prevent ponding of water and to provide drainage, except in areas to be immediately excavated.

9. Trees and stumps may be cut off as close to natural ground as practicable on areas which are to be covered by at least 3 feet of embankment.

10. Complete operations by bulldozing, blading, and grading so that prepared area is free of holes, unplanned ditches, abrupt changes in elevations and irregular contours, and preserve drainage of area.

3.03 UNSUITABLE MATERIAL

A. Undercut and replace material which Owner's Representative designates as unsuitable for subsequent construction.

B. Material used to replace unsuitable material shall be suitable material from site excavation or "Imported Fill" specified in this section.

3.04 EXCAVATION AND FILL

A. Depressed site areas shall be filled using material from high areas, insofar as practicable.

B. Fill to indicated rough grade elevations with "Imported Fill" material, when fill obtained from high areas is exhausted.

C. Place and compact fill in accordance with Section 02221 – Embankment.

3.05 SALVAGEABLE ITEMS AND MATERIALS

A. Items designated by the Owner's Representative to be salvaged are to be carefully removed, so as to cause no damage to the salvaged items and delivered to Owner's storage yard.

3.06 DISPOSAL

A. Removal and dispose of excess material and debris resulting from work under this Section 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 02221

EMBANKMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Construction of embankments with excess excavated material and borrow.

1.02 UNIT PRICES

A. No separate payment will be made for embankment. Include cost in the unit price for work in related item.

1.03 TESTS

A. Tests and analysis of soil properties will be performed in accordance with ASTM D4318, ASTM D2216, and ASTM D698 under provisions of Section 01410 - Testing Laboratory Services.

1.04 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other features outside of embankment limits.

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

C. Repair damage.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Topsoil: Conform to requirements of Section 02920.

B. General Backfill: Excavated material, graded free of roots, lumps greater than 6 inches, rocks larger than 3 inches, organic material, and debris.

C. Structural Backfill (under pavement or structures): Select general backfill material from excavation or borrow meeting the following requirements:

1. Plasticity Index: not less than 12 or more than 20.

2. Maximum Liquid Limit: 45 unless approved by Owner’s Representative.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify borrow and excess excavated materials to be reused are approved.

B. Verify removals, and clearing and grubbing operations, have been completed.

3.02 PREPARATION

A. Fill test pits, or stump holes and other surface irregularities such as small swales: Backfill with embankment materials and compact in proper lift depths to requirements for embankment compaction.

B. Remove and dispose of muck and other unsuitable materials which will not consolidate. Backfill with embankment materials and compact to requirements for embankment.

C. Complete backfill of new utilities below future grade.

3.03 EMBANKMENT

A. Do not conduct placement operations during inclement weather or when existing ground or fill materials exceed 3 percent of optimum moisture content. Contractor may manipulate wet material to facilitate drying, by disking or windrowing at Contractor's expense.

B. Do not place embankment fill until density and moisture content of previously placed material comply with specified requirements.

C. Scarify areas to be filled to a minimum depth of 4 inches to bond existing and new materials. Mix with first fill layer.

D. Spread fill material evenly, from dumped piles or windrows, into horizontal layers approximately parallel to finished grade. Place to meet specified compacted thickness. Break clods and lumps and mix materials by blading, harrowing, discing, or other approved method. Each layer shall extend across full width of fill.

E. Each layer shall be homogeneous and contain uniform moisture content before compaction. Mix dissimilar abutting materials to prevent abrupt changes in composition of fill.

F. Layers shall not exceed the following compacted thickness:

1. Areas indicated to be under future paving or shoulders, to be constructed within 6 months: 6 inches when compacted with pneumatic rollers, or 8 inches when compacted with other rollers.

2. Other areas: 8 inches.

G. Where shown on plans for steep slopes, cut benches into slope and scarify before placing fill. Place increasingly wide horizontal layers of specified depth, to the level of each bench.

H. Build embankment layers on back slopes, adjacent to existing roadbeds, to level of old roadbed. Scarify top of old roadbed to minimum depth of four inches and recompact with next fill layer.

I. Construct to lines and grades shown on drawings.

J. Remove unsuitable material and excess soil not being used for embankment from the site in accordance with requirements of Section 01564 - Waste Material Disposal.

3.04 COMPACTION

A. Maintain moisture content of embankment materials to attain required compaction density.

B. 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 under future paving and shoulders: Minimum density of 95 percent of maximum dry density.

2. Other areas: Minimum density of 90 percent of maximum dry density.

3.05 TOLERANCES

A. Top of compacted surface: Plus or minus 1/2 inch in cross section, or in 16 foot length.

3.06 FIELD QUALITY CONTROL

A. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 under provisions of Section 01410 - Testing Laboratory Services.

B. For roadways, a minimum of three tests will be taken for each 1,000 linear feet per lane or 1000 square yards of embankment per lift for all other areas.

C. If tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

3.07 PROTECTION

A. Conform to protection requirements of Section 02225 - Roadway Excavation.

END OF SECTION

SECTION 02225

EXCAVATION AND BACKFILL FOR ROADWAYS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Excavation of materials for roadways.

B. Compaction of roadway subgrade.

C. Excavation of materials for roadside ditches and swales.

D. Section 02920 - Topsoil: Topsoil materials and placement.

1.02 UNIT PRICES

A. No separate payment will be made for excavation of material for roadway under this Section related roadway pavement items. Include payment in the unit price for applicable bid items.

B. No separate payment will be made for excavation of material for roadside ditches and swales. Regrading of ditches and swales shall be incidental to applicable bid items.

1.03 TESTS

A. Tests and analysis of soil materials will be performed in accordance with ASTM D4318, ASTM D2216, and ASTM D698 under provisions of Section 01410 - Testing Laboratory Services.

1.04 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other features outside of grading limits.

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

C. Repair damage caused by 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 PREPARATION

A. Identify required lines, levels, and datum. Coordinate with Section 01050 - Field Surveying.

B. Identify and flag surface and aerial utilities.

C. Notify utility companies to remove or relocate utilities. Galveston is not a part of Texas One Call. Call 409-797-3630 for Galveston Public Works Department during normal business hours and 409-766-2115 after business hours for emergency situations.

D. Identify known utilities below grade. Stake and flag locations. Make temporary or permanent removals and replacements of underground pipes, ducts, or utilities where indicated on Drawings

E. Upon discovery of unknown or badly deteriorated utilities, or concealed conditions, discontinue work. Notify Owner's Representative and obtain instructions before proceeding in such areas.

F. Obtain approval of topsoil quality before excavating and stockpiling.

3.02 TOPSOIL EXCAVATION

A. Excavate top 4 inches of topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area designated on site.

B. Stockpile topsoil to height not exceeding 8 feet. Cover to protect from erosion.

3.03 SOIL EXCAVATION

A. Excavate to lines and grades shown on drawings.

B. Remove unsuitable material not meeting specifications. Backfill with embankment materials and compact to requirements of Section 02221 - Embankment.

C. Maintain proper drainage.

D. Fill over-excavated areas in accordance with requirements of Section 02221 - Embankment, at no cost to the Owner.

E. Remove unsuitable material, and excess soil not being reused, from the site in accordance with requirements of Section 01564 - Waste Material Disposal.

3.04 COMPACTION

A. Maintain optimum moisture content of subgrade to attain required compaction density.

B. 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 under future paving and shoulders: Minimum density of 95 percent of maximum dry density.

2. Other areas: Minimum density of 90 percent of maximum dry density.

3.05 TOLERANCES

A. Top of compacted surface: Comply with finished surface and thickness tolerances of Sections 02510- Asphaltic Concrete Pavement and Section- 02521.

3.06 FIELD QUALITY CONTROL

A. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of three tests will be taken for each 1,000 linear feet per lane of roadway.

C. If tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

3.07 PROTECTION

A. Prevent erosion at all times. Maintain ditches and cut temporary swales to allow natural drainage in order to avoid damage to roadway. Do not allow water to pond.

B. Protect exposed areas having high moisture content from wheel loads that cause rutting.

C. Maintain excavation and embankment areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no cost to the Owner.

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.

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.

a. 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 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 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 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 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 02532

CURB, CURB & GUTTER

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb.

B. Paving headers poured monolithically with concrete base or pavement.

1.02 UNIT PRICES

A. Measurement for curbs and for curbs and gutter is on linear foot basis measured along face of curb.

B. Measurement for headers is on linear foot basis measured between lips of gutters adjacent to concrete base and measured between backs of curbs adjacent to concrete pavement.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all sections and provisions of these specifications.

B. Submit details of proposed formwork for approval.

C. 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.

D. Submit manufacturer's certifications 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. Grout: Nonmetallic, nonshrink grout containing no chloride producing agents conforming to the following requirements.

Compressive strength, psi	
at 7 days	3500
at 28 days	8000
Initial set time, minutes	45
Final set time, hours	1.5

D. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02523.

E. Joint Sealing Compound: Conform to material requirements of Section 02523.

F. Mortar: Mortar finish composed of one part Portland cement and 1-1/2 parts of fine aggregate. Use only when approved by the Owner's Representative.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Prepare subgrade or base in accordance with applicable portions of Sections 02221 and 02225.

3.02 PLACEMENT

A. Guideline: Set to follow top line of curb. Attach indicator to provide constant comparison between top of curb and guideline. Insure flow lines for monolithic curb and gutters conform to slopes indicated on Drawings.

B. Forms: Brace sufficiently to maintain position during pour. Use metal templates cut to section shown on Drawings.

C. Reinforcement: Secure in proper position so that steel will remain in place throughout placement.

D. Joints: Place in accordance with Section 02523. Place dummy groove joints at 6-foot centers at right angles to curb lines. Cut dummy grooves 1/4 inch deep using an approved edging tool.

E. Place concrete in forms to required depth. Consolidate thoroughly. Do not permit rock pockets in form. Entirely cover top surfaces with mortar.

3.03 MANUAL FINISHING

A. After concrete is in place, remove front curb forms. Form exposed portions of curb, and of curb and gutter, using mule which conforms to curb shape, as shown on Drawings.

B. Thin coat of mortar may be worked into exposed face of curb using mule and two-handled wooden darby at least 3 feet long.

C. Before applying final finish move 10-foot straightedge across gutter and up curb to back form of curb. Repeat until curb and gutter are true to grade and section. Lap straightedge every 5 feet.

D. Steel trowel finish surfaces to smooth, even finish. Make face of finished curb true and straight.

E. Edge outer edge of gutter with 1/4-inch edger. Finish edges with tool having 1/4-inch radius.

F. Finish visible surfaces and edges of finished curb and gutter free from blemishes, form marks and tool marks. Finished curb or curb and gutter shall have uniform color, shape and appearance.

3.04 MECHANICAL FINISHING

A. Mechanical curb forming and finishing machines may be used instead of, or in conjunction with, previously described methods, if approved by the Owner Representative. Use of mechanical methods shall provide specified curb design and finish.

3.05 CURING

A. Immediately after finishing operations, cure exposed surfaces of curbs and gutters in accordance with Section 02525.

3.06 TOLERANCES

A. Top surfaces of curb and gutter shall have uniform width and shall be free from humps, sags or other irregularities. Surfaces of curb top, curb face and gutter shall not vary more than 1/8 inch from edge of a 10-foot long straightedge laid along them, except at grade changes.

3.07 PROTECTION

A. Maintain curbs and gutters in good condition until completion of Work.

B. Replace damaged curbs and gutters to comply with this Section.

END OF SECTION

SECTION 02570

PAVEMENT REPAIR AND RESURFACING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Repairing and resurfacing streets, highways, driveways, sidewalks and other pavements that have been cut, broken or otherwise damaged during construction.

B. Repairing areas of failed paving in preparation for resurfacing

1.02 UNIT PRICES

A. Unit Prices:

1. No separate payment shall be made for pavement repair and resurfacing under this Section. Payment shall be in accordance with Measurement and Payment for work as required in appropriate sections.

B. Stipulated Price (Lump Sum):

1. If contract is a stipulated price contract, payment for work in this Section is included in the total stipulated price.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Subgrade: 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.

B. Base: 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.

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.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. 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.

B. Conform to requirement of Section 02076 – Remove Existing Pavements and Structures, for removals.

C. 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.

D. 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.

E. 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.

F. 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.

G. Temporarily fill hole with base material or bridge with three-quarter inch steel plates until ready to place concrete.

3.02 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.

3.03 WASTE MATERIAL DISPOSAL

A. Dispose of waste material in accordance with requirements of Section 01564 – Waste Material Disposal.

3.04 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 02604

VALVE BOXES, METER BOXES, AND METER VAULTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Valve boxes for water service.

B. Meter boxes for water service.

C. Meter vaults for water service.

D. Valve boxes for water main and hydrant valves.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts:

1. No separate payment will be made for valve boxes or meter boxes for water service under this section. Include payment in unit price for Section 02665 – Water Tap and Service Line Installation.

2. No separate payment will be made for valve boxes for water mains/hydrants valves under this section. Include payment in unit price for Section 02645 – Fire Hydrant Assembly or 02664 – Water Mains as applicable.

3. Payment for each size of meter vaults is on a unit price basis per vault. Payment will be made for each vault installed, regardless of depth.

4. Refer to Section 01025 – Measurement and Payment.

B. Stipulated Price (Lump Sum) Contracts: If Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. Section 01025 – Measurement and Payment

B. Section 01300 – Submittals

C. Section 02620 – PVC Pipe

D. Section 02645 – Fire Hydrant Assembly

E. Section 02664 – Water Mains

F. Section 02665 – Water Tap and Service Line Installation

G. ASTM D 2240 – Standard Test Method for Rubber Property-Durometer Hardness

1.04 SUBMITTALS

A. Conform to requirements of Section 01300 – Submittals.

B. Submit manufacturer's product data for the following items for approval:

1. Each type of valve box and lid.

2. Each type of meter box and lid.

3. Each type of meter vault and cover.

C. Submit design calculations and shop drawings for precast meter vault with piping layout, sealed by an Engineer registered in the State of Texas, if proposed meter vault deviates from City details.

D. Submit design calculations and shop drawings for cast-in-place meter vaults, sealed by an Engineer registered in the State of Texas.

PART 2 PRODUCTS

2.01 VALVE BOXES

A. Valve Boxes for Water Service

1. Provide valve boxes by DFW Plastics, Inc. for 3/4-inch to 2-inch water services for customer side isolation valves. Model No. DFW109.9.2.

2. Valve box body:

a. Color – Black

b. Model No.: DFW109-9-BODY

3. Valve box lid:

a. Color - Blue, Markings – Letters "I.C.V."

b. Model No.: DFW109-3M-LID

4. Combined Box and Lid:

a. Model No.: DFW109-9-3M

B. Valve Boxes for Water Main and Hydrant Valves

1. Provide Type A, slip type, valve boxes by SIP Industries, Star Pipe Products, or approved equal.

2. Materials to be cast iron or ductile iron unless otherwise noted in the Plans.

3. Valve box body to be painted blue unless otherwise indicated on the Plans.

4. Cast letter water "W" into lid, for valves servicing water mains and flushing hydrants. Cast letter fire "F" for valves servicing fire hydrants.

5. Riser pipes to be 6-inch PVC, DR 18, in accordance with Section 02620 – PVC Pipe.

6. Concrete collars:

   a. Valve boxes in new concrete pavement; use strength and mix design of new pavement.

   b. For other locations, use class "A" concrete, with a minimum compressive strength of 3,500 psi, in accordance with Section 03305 – Concrete for Utility Construction.

2.02 METER BOXES

A. Provide meter boxes by DFW Plastics, Inc. for 5/8 x 3/4-inch to 2-inch water meters.

B. Meter box types and sizes shall be based on the location and application as indicated in Table 2.02 below:

Meter Size (IN)	Application	Location	Model No. (Combined)
5/8 x 3/4 3/4 1	Residential Irrigation Commercial	Non-Vehicular Traffic Area	DFW1300-12-(3)MT
		Vehicular Traffic Area	DFW37C-12-AF3MT SMALL GAL
1-1/2	Residential Irrigation Commercial	Non-Vehicular Traffic Area	DFW1600-12-(3)MT
		Vehicular Traffic Area	DFW65C-12-AF3MT SMALL GAL
2	Residential Irrigation Commercial	All Locations	DFW65C-14-AF3MT SMALL GAL
Dual 5/8 x 3/4 3/4 1	Residential Irrigation Commercial	Non-Vehicular Traffic Area	DFW1300X-12-(3)MT
		Vehicular Traffic Area	DFW38C-14-AF3MT SMALL GAL

Table 2.02 – Meter Box Type and Size

1. Table 2.02 provides model numbers for complete (body and lid) meter boxes. See the 2.02C and 2.02D for individual meter box body and lid model numbers.

2. Dual meters in a single meter box are prohibited for domestic services greater than 1-inch.

C. Meter box body:

1. Non-vehicular Traffic Areas:

    a. 5/8x3/4 to 1-inch: DFW1300-12-BODY

    b. 1-1/2-inch: DFW1600-12-BODY

    c. 2-inch: DFW65C-14-BODY

    d. Dual Meters: DFW1300X-12-BODY

2. Vehicular Traffic Areas:

    a. 5/8x3/4 to 1-inch: DFW37C-12-BODY

    b. 1-1/2 to 2-inch: DFW65C-14-BODY

    c. Dual Meters: DFW38C-14-BODY

D. Meter box lids:

1. Anti-float material, magnetic detector installed for locating, and compatible with City specified Advanced Metering Infrastructure endpoints.

2. Color – blue.

3. Markings:

    a. City of Galveston Logo

    b. Letters “WATER METER”.

4. Non-vehicular Traffic Areas:

    a. 5/8x3/4 to 1-inch: DFW1200E-(3)MT-LID

    b. 1-1/2-inch: DFW1600E-(3)MT-LID

    c. 2-inch: DFW65C-AF3MT SMALL GAL-LID

    d. Dual Meters: DFW1200E-(3)MT-LID

5. Vehicular Traffic Areas:

    a. 5/8x3/4 to 1-inch: DFW37C-AF3MT SMALL GAL-LID

    b. 1-1/2 to 2-inch: DFW65C-AF3MT SMALL GAL-LID

    c. Dual Meters: DFW38C-AF3MT SMALL GAL-LID

2.03 METER VAULTS

A. Meter Vaults shall be constructed of precast, or cast-in-place concrete to the specified dimensions on City details unless otherwise noted in the Plans.

B. Cast-in-place vault walls and floors shall be of monolithic construction.

C. Joints: Hydrophilic waterstops are required for all vault joints.

D. Concrete: Class "A" concrete, with a minimum compressive strength of 4,500 psi, in accordance with Section 03305 – Concrete for Utility Construction.

E. Reinforcing steel: Conform to Section 03305 – Concrete for Utility Construction.

F. Interior piping shall be supported by concrete pipe supports as indicated on Detail No. 02604-01 Typical Meter Vault for Meters 3-Inch to 8-Inch.

G. Wall penetrations for incoming and outgoing service piping shall include wall sleeves with integral water stops and link-type modular compression seals by Link-Seal or approved equal.

H. Covers: Conform to Section 02603 – Frames, Grates, Rings, and Covers.

1. Covers shall include a 30-inch by 48-inch single leaf aluminum hatch with stainless steel hinges, slamlock, and safety net.

2. Covers shall be compatible with City specified Advanced Metering Infrastructure endpoints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Written approval from the City shall be obtained for the location of meter vaults.

B. Verify lines and grades are correct.

C. Verify compacted subgrade will support loads imposed by vaults.

3.02 VALVE BOXES

A. Valve Boxes for Water Service

1. Install valve boxes for water service a maximum of 18-inches from the meter box, out of vehicular traffic areas unless otherwise indicated on the plans.

2. Valve boxes required to be installed in vehicular traffic areas shall be installed with a concrete collar in accordance with Detail No. 02607-01 Concrete Collar for Valves and Manholes.

3. Set, align, and adjust valve box so that lid is level with finished grade.

B. Valve Boxes for Water Mains and Hydrant Valves

1. Install PVC riser pipe of suitable length for depth of cover indicated on the Drawings adjusted to length necessary to accommodate actual finished grade.

a. Install riser pipe in a plumb, vertical position, with the bell on top of the valve.

b. Provide 6-inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box to accommodate vertical movement. The end of riser pipe resting on valve shall be notched out sufficiently to provide a snug fit around the valve bonnet and to center valve inside of riser pipe.

2. Set, align, and adjust valve box so that lid is level with finished grade.

3. Paint covers of new valve boxes orange when installed until roadway/trench restoration is complete. After completion of all roadway scope, paint valve boxes blue as indicated in Paragraph 2.01.B. of this Section.

4. Install concrete collars around valve boxes in accordance with Detail No. 02607-01 Concrete Collar for Valves and Manholes.

3.03 METER BOXES

A. Meter boxes shall be installed in accordance with the manufacturer's recommendations and City Detail No. 02665-01 Typical Water Services for Meters 2-Inch and Under.

B. Meter boxes shall be installed flush with finished grade. For curb streets, locate meter boxes 12-inches to 18-inches from the back of curb. For streets with roadside ditches, locate meter boxes a minimum of 18-inches from the top bank of the roadside ditch.

C. Meter boxes shall be located out of vehicular traffic areas unless otherwise indicated on the plans.

D. When unavoidable, meter boxes installed in vehicular traffic areas shall be traffic rated as indicated in Table 2.02.

3.04 METER VAULTS

A. Construct concrete meter vaults to the dimensions shown on City Detail 02604-01 Typical Meter Vault for Meters 3-Inch to 8-Inch. Interior meter vault depth shall not exceed depth indicated on the detail without written authorization from the City.

B. Precast Meter Vaults

1. Install precast meter vaults in accordance with manufacturer's recommendations.

2. Set meter vault level on a minimum 6-inch-thick bedding of compacted cement stabilized sand in accordance with Section 02252 – Cement Stabilized Sand.

3. Seal lifting lugs with non-shrink grout.

C. Meter Vault Floor Slab:

1. Floor slabs shall be constructed of 6-inch-thick reinforced concrete.

2. Sumps pits with drains are prohibited.

3. Install dowels at a maximum of 18-inches on center for keying walls to floor slab.

4. Precast floor slab elements may be used for cast-in-place vault construction.

D. Cast-in-Place Meter Vaults

1. Do not cast in the presence of water.

2. Key walls to floor slab. Hydrophilic waterstops are required for all joints between wall and floor slab. Minimum wall thickness shall be 6-inches.

3. Walls and floors are to be cast monolithically.

4. Set frame for metal cover in concrete.

3.05 FRAME AND COVER FOR METER VAULTS

A. In paved areas, covers shall be constructed of 6-inch-thick reinforced concrete.

1. Set top of cover flush with adjacent concrete.

2. 1/2-inch redwood isolation joints required between vault and adjacent concrete.

B. In unpaved areas, covers shall be galvanized steel.

1. Covers shall be installed on a 1/4-inch x 6-inch continuous 60 durometer neoprene bearing pad.

2. Set frame for metal cover in concrete.

3. Set top of cover 4-inches above finished grade.

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 away at a minimum 1:5 slope.

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 and installation of concrete collar per City of Galveston Standard Details.

1.02 UNIT PRICES

A. Measurement for adjusting utility structures to grade is on a per EACH 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 benchmark 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, unless directed otherwise by Owner’s Representative.

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.

G. After manhole or inlet has been set, aligned, and adjusted so that top lid is level with final grade, pour a reinforced concrete collar around the manhole or inlet per City of Galveston Standard Details. Center manhole or inlet horizontally within the collar.

3.04 ADJUSTING VALVE BOXES

A. Salvage and reuse valve box and surrounding concrete block, unless directed otherwise by the Owner’s Representative.

B. Remove and replace 6-inch riser pipe in accordance with City of Galveston 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 reinforced concrete collar around the valve box per City of Galveston Standard Details. 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 the manhole collar block out. Place earth fill around the valve box collar block out.

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

1.1 SECTION INCLUDES

A. New steel pipe and fittings for pumping facilities, and casings.

1.2 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.

1.3 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.

1.4 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

2.1 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.

2.2 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.

2.3 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.

2.4 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.

2.5 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.

2.6 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

3.1 PIPING INSTALLATION

A. Conform to applicable provisions of Section 02664 - Water Mains except as modified herein.

3.2 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.

3.3 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.

3.4 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.

D. 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.

E. 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.

F. 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 re-inspect.

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.

3.5 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 02620

PVC PIPE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Polyvinyl chloride (PVC) pressure pipe for water distribution in nominal diameters 4 inches through 24 inches.

B. Polyvinyl chloride sewer pipe for gravity sanitary sewers in nominal diameters 4 inches through 60 inches.

C. Polyvinyl chloride pressure pipe for sanitary sewer force mains in nominal diameters 4 inches through 12 inches.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts: No separate payment will be made for PVC pipe under this section. Include cost in unit price for work included as specified in the following sections:

1. Section 02664 – Water Mains
2. Section 02720 – Storm Sewers
3. Section 02730 – Gravity Sanitary Sewers
4. Section 02731 – Sanitary Sewer Force Mains

B. Stipulated Price (Lump Sum) Contract: If Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ANSI A 21.16 (AWWA C 116) - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron.

B. ASTM A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

C. ASTM C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

D. ASTM D 618 - Standard Practice for Conditioning Plastics for Testing.

E. ASTM D 1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

F. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

G. ASTM D 2122 – Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

H. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

I. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

J. ASTM D 2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading.

K. ASTM D 2444 - Standard Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

L. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

M. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

N. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

O. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

P. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

Q. ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

R. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

S. ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.

T. AWWA C 110 (ANSI A 21.10) - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch Through 48-inch, for Water and Other Liquids.

U. AWWA C 111 (ANSI A 21.11) - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

V. AWWA C 153 (ANSI A 21.53) - Ductile-Iron Compact Fittings for Water Service.

W. AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 MM Through 1,500 MM).

X. AWWA C909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100mm) and Larger.

Y. AWWA M23 – PVC Pipe – Design and Installation.

Z. PPI TR-3 - Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe.

AA. UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

1.04 SUBMITTALS

A. Conform to requirements of Section 01300 – Submittals.

B. Submit shop drawings showing the design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

C. Contractor to review and submit PVC pipe manufacturers recommended installation procedures.

D. Calculations and limits of thrust restraint shall be based on AWWA M23, latest edition.

1.05 QUALITY ASSURANCE

A. Submit manufacturer's certifications that PVC pipe meets requirements of this Section and AWWA C900 for pressure pipe applications, or the appropriate ASTM standard specified for PVC pipe.

B. Submit manufacturer's certification that PVC pressure pipe has been hydrostatically tested at the factory in accordance with AWWA C 900 and this Section.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Inspect pipe upon arrival at job site.

B. Handle and store pipe materials to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe along ground. Do not roll pipe unrestrained from delivery trucks.

C. Use mechanical means to move or handle large pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings.

PART 2 PRODUCTS

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 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.

Table 2.01: Gasket Requirements

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 30-inch: AWWA C 900, Class 235, DR 14; nominal 20-foot lengths; cast iron equivalent outside diameters.

B. 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.

C. 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.

D. Hydrostatic Test: AWWA C 900, 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 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 be 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:

Table 2.04: PVC Pipe Requirements

Manufacturer	Product Application	Standard	SDR (Max)/Stiffness	Size Range
Diamond Plastics Corporation	Gravity Sewer	ASTM D3034	SDR 26	4” to 15”
IPEX USA LLC				
Jet Stream by PipeLife				
JM Eagle				
National Pipe & Plastics, Inc.				
Sanderson Pipe Corporation				
Westlake Pipe and Fittings				
Diamond Plastics Corporation	Gravity Sewer	ASTM F679	PS 115	18” to 60”
IPEX USA LLC				
Jet Stream by PipeLife				
JM Eagle				
National Pipe & Plastics, Inc.				
Sanderson Pipe Corporation				
Westlake Pipe and Fittings				
Diamond Plastics Corporation	Force Main or where pressure rated pipe required	AWWA C900	DR 14*	4” to 12”
IPEX USA LLC				
Jet Stream by PipeLife				
JM Eagle				
National Pipe & Plastics, Inc.				
Sanderson Pipe Corporation				
Westlake Pipe and Fittings				
*Higher DR wall thicknesses may be acceptable if design calculations support their use. All calculations shall be signed and sealed by a licensed Texas PE and submitted for approval prior to acceptance.				

B. When solid wall PVC pipe 18 inches to 60 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 stiffness 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. Alternatively, PVC pipe in accordance with ASTM D3034 SDR 26 or ASTM F679 PS 115 can be utilized of certification can be provided that the pipe is capable of withstanding 150 psi.

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 factoryassembled 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-B13, 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 EXECUTION

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. 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 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 02640

GATE VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Furnishing and installing gate valves for underground/buried use. See section 15101 for above ground service.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this Section. Include payment in unit price for relate work.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01300 - Submittals.

B. Submit manufacturer's product data for proposed valves for approval.

1.04 QUALITY CONTROL

A. Provide manufacturer's affidavit that all gate valves have been satisfactorily tested in the United States in accordance with AWWA C500 and C509.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Gate Valves: AWWA C500, C509 and additional requirements of this Section; direct bury and in subsurface vaults open counterclockwise.

B. If type of valve is not indicated on Drawings, gate valves shall be used as line valves for sizes less than 16-inches. If type of valve is specified, no substitute will be allowed.

C. Gate Valves 1-1/2 Inches in Diameter and Smaller: 125 psig; bronze; rising-stem; single-wedge; disc type; screwed ends; Crane No. 428, or equal.

D. Coatings for Gate Valves 2 Inches and Larger: AWWA C550; Indurall 3300 or approved equal; non-toxic; not impart taste to water; function as physical, chemical, and electrical barrier between base metal and surroundings; minimum 8-mil-thick; fusion-bonded epoxy; prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.

E. Gate Valves 2 Inches in Diameter: Iron body; double gate; non-rising stem; 150-pound test; 2-inch square nut operating clockwise to open.

F. Gate Valves 4 Inches to 12 Inches in Diameter: Non-directional; resilient seated (AWWA C509) or parallel seat double disc (AWWA C500); 200 psig; bronze mounting; push-on bell ends with rubber joint rings and nut operated unless otherwise specified; resilient seated provide American Darling 2500-1, US Pipe Metroseal 200 or approved equal; double disc provide American Darling 52, Clow F-6110 or approved equal; and comply with following:

1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.

2. Body: Cast or ductile iron; flange bonnet and stuffing box together with ASTM A307 Grade B bolts. Cast in body manufacturer's initials, pressure rating, and year manufactured.

3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.

4. Stems: ASTM B763 bronze, alloy number 995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12%; non-rising.

5. "O" Rings: AWWA C509, sections 2.2.6 and 4.8.2.

6. Stem Seals: Consist of three "O" rings, two above and one below thrust collar with anti-friction washer located above thrust collar.

7. Stem Nut: Independent or integrally cast of ASTM B62 bronze.

8. Resilient Wedge: Molded; synthetic rubber; vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D429 Method B; seat against epoxy-coated surface in valve body.

9. Bolts: AWWA C509 Section 2.2.5; stainless steel; cadmium plated, or zinc coated.

G. Gate Valves 14 Inches to 24 Inches in Diameter: AWWA C500; push-on bell ends with rubber rings and nut operated unless otherwise specified; double disc; 150 psi; and comply with following:

1. Body: Cast or ductile iron; flange together bonnet and stuffing box with ASTM A307 Grade B bolts. Cast in body manufacturer's initials, pressure rating, and year manufactured. Equipped with rollers, tracks and scrapers.

2. Stems: Machined from ASTM B62 bronze rod with integral forged thrust collar machined to size; non-rising.

3. Stem Seals: Consist of one "O" ring above and one "O" ring below thrust collar with anti-friction washer located above thrust collar for operating torque.

4. Stem Nut: Independent or integrally cast of ASTM B62 bronze.

5. Discs: Cast iron with bronze disc rings securely peened into machined dovetailed grooves.

6. Wedging Device: Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Other moving surfaces integral to wedging action shall be bronze monel or nickel alloy-to-iron.

7. Bronze Mounting: Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for forces which will be imposed on it.

8. Gear Cases: Cast iron; furnished on all 18-inch and larger valves and of extended type with steel side plates; lubricated; gear case enclosed with oil seal or O-rings at all shaft openings.

9. Stuffing Boxes: Located on top of bonnet and outside gear case.

H. Gate Valves 20 Inches and Larger: Furnish and equip with bypass valves.

1. Sizes: Provide 3-inch bypass valves for 16-inch through 20-inch gate valves. Provide 4-inch bypass valves for 24-inch gate valves.

I. Valves 4 Inches through 12 Inches for Installation in Vertical Pipe Lines: Double disc, square bottom.

J. Valves 14 Inches and Larger for Installation in Horizontal Pipe Lines: Equipped with bronze shoes and slides.

K. Gate Valves Installed at Greater than 4-foot Depth: Provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade.

L. Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.

M. Provide flanged joints when valve is connected to steel.

PART 3 E X E C U T I O N

3.01 EARTHWORK

A. Conform to applicable provisions of Section 02227 - Excavation and Backfilling for Utilities.

3.02 SETTING VALVES AND VALVE BOXES

A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that all parts are in satisfactory working condition.

B. Install valves and valve boxes where shown 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. Install valves completely closed when placed in water line.

C. Regardless of type of pipe used in water line construction, pipe section of each valve box must be of cast iron, ductile iron, or DR18 PVC pipe cut to proper length. Size to allow proper future operation of valve. Assemble and brace box in vertical position as indicated on drawings.

3.03 DISINFECTION AND TESTING

A. Disinfect valves and appurtenances as required by Section 02675.

3.04 PAINTING OF VALVES

A. Paint valves in vaults, stations and aboveground using ACRO Paint No. 2215, "Galveston Blue" or approved equal, unless otherwise directed by the Owners Representative.

END OF SECTION

SECTION 02660

CHECK VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK:

A. Finish all labor, materials, equipment and incidentals required to completely install and put into operation, check valves as specified herein and shown on the plans.

1.01 REFERENCES:

A. City of Galveston's latest specifications

1.03 SUBMITTALS:

A. Contractor shall submit manufacturer's technical information on all valves and materials of construction.

1.03 WARRANTY:

A. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced, and the unit(s) restored to service at no expense to the Owner. Warranty shall be for a period of two years and begin on the Date of Final Acceptance.

PART 2 PRODUCTS

2.01 CHECK VALVES:

A. Double Door check valve shall be the compact wafer design to fit between ANSI flanges.

B. Nuts, Bolts, and Studs shall be Type 316 Stainless Steel.

C. The check valve doors shall be the spring loaded, normally closed, by means of one or more heavy-duty stainless-steel torsion springs.

D. The sealing shall be resilient Buna-N compression molded into the body for watertight shutoff.

E. Materials shall be certified to the following A.S.T.M. specifications:

Body	Cast iron	ASTM A126, Class B
Doors	Aluminum bronze	ASTM B148, C95200
Sealing Element	Buna-N	
Torsion Spring	T316 Stainless Steel	
Hinge Shaft	T316 Stainless Steel	
Stop Shaft	T316 Stainless Steel	

G. Acceptable Manufacturers – reference the latest version of City of Fair Oaks Ranch Material Standard Specification 29-02.

PART 3 EXECUTION

3.01 INSTALLATION:

A. All check valves shall be installed in accordance with instructions of the manufacturer as shown on the plans.

END OF SECTION

SECTION 02664

WATER MAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Installation of water mains.

1.02 MEASUREMENT AND PAYMENT

A. Measurement for water mains open cut or augered with or without casing is on a linear foot basis for each size of pipe installed.

1. Mains: Measure along axis of pipe and include fittings and valves.

2. Branch Pipe: Measure from axis of main to end of branch.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of all provisions and sections of these specifications.

B. Conform to submittal requirements of applicable specification section for type of pipe used.

C. Submit preconstruction and post construction photographs if required.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

A. Install pipe materials (as per this section) which conform to following:

1. Section 02610 - Ductile Iron Pipe (DIP) and Fittings.

2. Section 02611 - Steel Pipe and Fittings.

3. Section 02620 - Polyvinyl Chloride (PVC) Pipe.

B. Type of pipe materials used are identified on Drawings.

PART 3 EXECUTION

3.01 GENERAL

A. Conform to applicable specification sections for types of pipe used.

B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints. Lay pipe with bell ends facing in direction of laying.

C. Lay pipe to lines and grades shown on drawings. Use adequate surveying methods and equipment and employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record "as-built" horizontal alignment and vertical grade for on-site record drawings.

D. Confirm that separation from gravity sanitary sewers and manholes or force mains have minimum clearance of nine feet in all directions unless a special design is provided for on the drawings.

E. Where above clearance cannot be attained, and a special design has not been provided on Drawings, obtain direction from Owner's Representative before proceeding with construction.

F. Inform Owner's Representative if any unmetered sprinkler or fire line connections exist which are not shown on Drawings to be transferred to new main. Make transfer only after approval by Owner's Representative.

G. Keep pipe trenches free of water which might impair pipe laying operations. Prevent pipe bells from coming in contact with subgrade. Grade pipe trenches to provide uniform support along bottom of pipe. Excavate for bell holes for proper sealing of pipe joints after bottom has been graded and in advance of placing pipe. Lay not more than 100 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place all backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.

3.02 HANDLING, CLEANING AND INSPECTION

A. Handling:

1. Place pipe along project site where storm water or other water will not enter or pass through pipe.

2. Pipe and Fittings: Loaded, transported, unloaded and otherwise handled in manner and by methods which will prevent damage of any kind thereto. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings.

   Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.

3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.

4. Use every precaution to prevent injury to pipe, protective linings and coatings.

    a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.

    b. Pad fork trucks using carpet or some other suitable type of material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.

    c. Do not lift pipe using hooks at each end of pipe.

5. Repair damage to pipe or protective lining and coating before final acceptance by Owner at no additional cost to Owner.

6. Reject pipe with visible cracks and remove from project site.

B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After all pipe laying and joining operations are completed, clean inside of pipe and remove all debris.

C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

3.03 EARTHWORK

A. Conform to applicable provisions of Section 02227 - Excavation and Backfilling for Utilities and Section 02317 - Augering Pipe for Water Lines.

B. Bedding: Use bedding materials in conformance with Section 02229 - Utility Backfill Materials and detail in Drawings.

C. Backfill: Use bank run sand or earth or native soil as specified in Section 02229 Utility Backfill Materials and in accordance with detail in Drawings.

D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density. Take laboratory field density tests at Owner's Representative’s discretion.

E. Pipe Zone: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

3.04 PIPE CUTTING

A. Cut pipe 12-inch and smaller with standard wheel pipe cutters. Cut pipe larger than 12-inch in manner approved by Owner’s Represnetative. Make all cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

3.05 PIPING INSTALLATION

A. Do not lay pipe unless subgrade is free of water. Do not lay pipe when it is raining or when trench is muddy or soft. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material. Wedging or blocking up bell will not be acceptable.

B. Do not install pipe at greater depth than its design allows.

C. Protection of Pipeline: Securely place stoppers or bulkheads in all openings and in end of line when construction is stopped temporarily and at end of each day's work.

D. For nonmetallic pipe, install magnetic locator tape continuously along the top of the pipe.

E. Temporary services and mains shall be installed to ensure no interruption of water supply during installation of new water mains and services.

3.06 JOINTS AND JOINTING

A. Rubber Gasketed Bell-and-Spigot Joints (PVC and DIP):

1. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.

2. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.

3. After the pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary before remaking joint.

4. Where preventing movement of 12" diameter or greater pipe due to thrust is necessary, provide the following restrained joints, or equal:

a. Ductile-Iron Pipe:

(1) Super-Lock Joint by Clow Corporation/McWane Ductile.

(2) Flex-Ring or Lok-Ring by AMERICAN Cast Iron Pipe Company.

(3) TR-Flex or Field-Lok 350 by U.S. Pipe.

b. PVC Pipe:

(1) Fittings: Series 2000 PV Fitting Restrainer by EBAA Iron, Inc. (MEGALUG), or approved equal.

(2) Bell and Spigot: Series 1500/1600/1900 Joint Restrainer by Ebba Iron, Inc., or approved equal.

c. Steel Pipe: Welded joints (see Part 3.05C)

B. Flanged Joints (DIP, Steel):

1. AWWA C207. 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 vertical, horizontal or north-south centerline. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.

2. Use full-face gaskets for all flanged joints. Provide 1/8-inch thick cloth inserted rubber gasket material. Cut gaskets at the factory to proper dimensions.

3. Use galvanized or black nuts and bolts 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.

C. Welded Joints (Steel):

1. Joints: AWWA C206. Full-fillet, single lap-welded slip type either inside or outside, or double butt-welded type; use automatic or hand welders; provide complete penetration of deposited metal with base metal; provide filler metal suitable for use with base metal; keep inside of fittings and joints free from globules of weld metal which would restrict flow or become loose. Do not use mitered joints. For interior welded joints, complete backfilling before welding. For exterior field-welded joints, provide adequate working room under and beside pipe. Use exterior welds for 30-inch and smaller.

2. Bell-and-Spigot, Lap-Welded Slip Joints: Deflection may be taken at joint by pulling joint up to 3/4 inch as long as 1-1/2-inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as proper joint tolerances are maintained. Miter end cuts of both ends of buttwelded joints may be used for joint deflections of up to 5 degrees.

3. Align piping and equipment so that no part is offset more than 1/8 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. For butt-welded joints, align abutting ends to minimize offset between surfaces. For pipe of same nominal wall thickness, do not exceed 1/16 inch offset. Use line-up clamps for this purpose; however, care shall be taken to avoid damage to linings and coatings.

4. Protect coal-tar-epoxy lining during welding by draping an 18-inch-wide strip of heat-resistant material over top half of pipe on each side of lining holdback to avoid damage to lining by hot splatter. Protect tape coating similarly if external welding is required.

5. Welding Rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.

6. Deposit metal in successive layers to provide at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in completed weld.

7. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each individual pass with wire brush or hammer to remove dirt, slag or flux.

8. Do not weld under any weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless work is properly protected.

9. Tack weld of same material and make by same procedure as completed weld. Otherwise, remove tack welds during welding operation.

10. Remove dirt, scale and other foreign matter from inside piping before tying in sections, fittings or valves.

D. Joint Grout (Steel):

1. Mix grout by machine except when less than 1/2 cubic yard is required. When less than 1/2 cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Use grout within 20 minutes after mixing. Discard grout that has set. Retempering of grout by any means is not permitted.

2. Prepare grout in small batches to prevent stiffening before it is used. Any grout which has become so stiff that proper placement cannot be assured without retempering by any means shall be wasted. Provide grout for filling grooves of such consistency that it will adhere to ends of pipe.

3. Surface Preparation: Remove all defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces with wire brush or hammer to sound, clean surface. Remove rust and all foreign materials from all metal surfaces in contact with grout.

4. Follow established procedures for hot and cold weather concrete placement.

5. Complete joint grout operations and backfilling of pipe trenches as closely as practical to pipe laying operations. Allow grouted exterior joints to cure at least 1 hour before compacting backfill.

6. Grouting exterior joint space: Use minimum 9-inch-wide Ethafoam "diaper" or wrapper placed around pipe and over joint. Hold wrapper in place on both sides of joint with minimum 5/8-inch-wide steel straps or bands. Place no additional bedding or backfill material on either side of pipe until after grout band is filled and grout has mechanically stiffened. Pull ends of wrapper together at top of pipe to form access hole. Pour grout down one side of pipe until it rises on other side. Rod or puddle grout to ensure complete filling of the joint recess. Agitate for 15 minutes to allow excess water to seep through joint band. When necessary, add more grout to fill joint completely. Protect gap at top of joint band from backfill by allowing grout to stiffen or by covering with a structurally protective material. Do not remove band from joint.

7. Interior Joints for Pipe Smaller than 24-Inch: Circumferentially butter bell with grout prior to insertion of spigot, strike off flush surplus grout inside pipe by pulling filled burlap bag or inflated ball through pipe with rope.

8. Protect exposed interior surfaces of steel joint bands by metallizing, by other approved coatings, or by pointing with grout. Joint pointing may be omitted on potable water pipelines if the joint bands are protected by zinc metallizing or other approved protective coatings.

9. Remove and replace all improperly cured or otherwise defective grout at no additional cost to Owner.

10. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply flexible sealer, such as Flex Protex by Gifford-Hill America, or equal, to outside joint prior to joint engagement. Clean and prime surfaces receiving sealer in accordance with manufacturer's recommendations. Apply sufficient quantities of sealer to assure complete protection of all steel in joint area. Fill interior of joint with grout in normal manner after joint closure.

E. Joint Testing:

1. In addition to testing individual joints with feeler gage approximately 1/2-inch wide and 0.015-inch thick, use any other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. These tests shall be made at no additional cost to Owner.

2. On any joint or seam welded after hydrostatic testing or not subjected to hydrostatic testing, test 100 percent of welded joint by methods as described in section on Welded Joints. Owner reserves right to require Contractor to make additional tests at Owner's expense except that if tests performed at Contractor's expense or Owner's expense indicate an unacceptable weld, then cost of test, subsequent repair of rejected weld and test of repaired weld shall be borne by Contractor.

F. Make curves and bends by deflecting joints or other method as approved by manufacturer and Owner’s Representative.

1. Deflection of pipe joints shall not exceed maximum deflection recommended by AWWA and pipe manufacturer, unless otherwise indicated on Drawings.

2. If deflection exceeds maximum allowable, the contractor shall remove and install new pipe.

3. Contractor shall replace, repair or reapply coatings and linings as required above.

4. No additional payment will be made for above described work.

5. Assessment of deflection may be measured by Owner at any location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.

6. Contractor may submit details of other methods of providing curves and bends for consideration by Owner's Representative, and if deemed satisfactory, shall be installed at no additional cost to Owner.

7. When rubber gasketed pipe is laid on a curve, joint pipe in a straight alignment and then deflect to curved alignment.

G. Closures and Field Modifications:

1. Apply welded-wire fabric reinforcement to interior and exterior of all exposed interior and exterior surfaces greater than 6 inches in diameter. Welded-wire fabric: minimum W1; maximum spacing 2 inches by 4 inches; 3/8 inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than 3/4 inch.

2. Fill all exposed interior and exterior surfaces with nonshrink grout.

3.07 SECURING, SUPPORTING AND ANCHORING

A. Support piping as shown on Drawings and as specified herein, to maintain line and grade and prevent transfer of stress to adjacent structures.

B. Where shown on Drawings, anchor pipe fittings and bends installed on water main by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begin upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).

C. Provide adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Provide sufficient anchorage and blocking to resist all stresses and forces encountered while tapping existing waterline.

3.08 THRUST RESTRAINT

A. For new water lines 12 inches in diameter and larger, restrain joints as specified in Part 3.06 A.4 of this section. The new water line shall also be additionally restrained with concrete thrust blocking.

B. For existing waterlines and waterlines less than 12 inches in diameter, restrain pipe joints with concrete thrust blocks or provide joints as specified in Part 3.06A.4 of this section.

C. Prevent any lateral movement of thrust restraints throughout pressure testing and operation. Place 2500 psi concrete conforming to Section 03305, Concrete for Utility Construction, for

blocking at each change in direction of existing water lines, and water lines 12 inches in diameter and smaller to brace pipe against undisturbed trench walls. Complete placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made 2 days after completion of blocking if Type II cement is used.

3.09 POLYETHYLENE WRAP

A. Double wrap all ductile iron pipe and appurtenances (except fire hydrants) with 8-mil polyethylene film.

B. Conform to requirements of Section 02630 - Polyethylene Wrap.

3.10 CLEANUP, RESTORATION AND PAYMENT

A. Provide "cleanup" and "restoration" crews to work closely behind pipe laying crews, and where necessary, during chlorination, testing, service transfers, abandonment of old mains, backfill and surface restoration.

B. Upon completion of water line installation in a street and prior to moving to another, chlorinate and pressure test. Provide City a sampling point every 1000 L.F. for testing. Begin transfer of services no later than seven calendar days after successful completion of chlorination and pressure testing.

C. After completion of transfer of services, but no later than 21 calendar days after successful completion of chlorination and pressure testing, begin abandonment of old mains, backfill, resod, and placement of sidewalks and pavements.

D. Do not begin construction of additional sections if above conditions are not met.

3.11 CLEANING PIPING SYSTEMS

A. Remove construction debris or foreign material and thoroughly clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning.

3.12 DISINFECTION OF WATERLINES

A. Conform to requirements of Section 02675 - Disinfection of Waterlines.

3.13 FIELD HYDROSTATIC TESTS

A. Conform to requirements of Section 02676 - Hydrostatic Testing of Pipelines.

END OF SECTION

SECTION 02665

WATER TAP AND SERVICE LINE INSTALLATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tapping new or existing water mains and installing new water service lines 2-inches and under.

B. Relocation of existing small water meters.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts:

1. Measurement for 1-inch water taps and service lines is on a lump sum basis for each installation.

2. Measurement for 2-inch water taps and service lines is on a lump sum basis for each installation.

3. Measurement for relocation of existing water meters 2-inch and smaller is on a lump sum basis for each size water meter relocated.

4. Payment for water tap and service line installation includes locating water main, tap installation, corporation stop, service tubing, meter box, curb stop, customer side gate valve with valve box, piping, service fittings, and all appurtenances necessary for complete installation of water service.

5. Payment for relocating existing water meters 2-inch and smaller includes meter couplings, fittings, and relocation of the meter and meter box as necessary for complete restoration of water service.

6. No separate payment shall be made for bedding and backfill or compaction.

B. Stipulated Price (Lump Sum) Contract: If Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. Section 01025 – Measurement and Payment

B. Section 01300 – Submittals

C. Section 02604 – Valve Boxes, Meter Boxes, and Meter Vaults

D. Section 02627 – Water Meters

E. Section 02640 – Gate Valves

F. AWWA C800 –Underground Service Line Valves and Fittings

G. AWWA C901 – Polyethylene (PE) Pressure Pipe and Tubing, 3/4-Inch Through 3-Inch, for Water Service

PART 2 PRODUCTS

2.01 MATERIALS

A. Tapping Saddle: Tapping saddle type and size shall be in accordance with Table 2.01 below:

Pipe Tapping Schedule		
Water Main Type and Size	Service Tap Size/Saddle Type[1]	
	1"	2"
Cast/Ductile Iron (4" - 12")	DSS, WBSS	DSS, WBSS
Cast/Ductile Iron (≥16")	DWBSS	DWBSS
PVC (4" - 12")	DSS, WBSS	DSS, WBSS
PVC (≥16")	DWBSS	DWBSS
Asbestos Concrete (4")	WBSS	WBSS
Asbestos Concrete (6" - 12")	WBSS, DWBSS	WBSS, DWBSS
Asbestos Concrete (≥16")	DWBSS	DWBSS

Table 2.01
[1]DSS – Dual Strap Saddles
WBSS – Wide Band Strap Saddles
DWBSS – Dual Wide Band Strap Saddles

1. Dual Strap Saddles – Red brass, bronze, epoxy coated, or vinyl coated ductile iron body; stainless steel u-bolt straps, washers, and nuts.

2. Wide Band Strap Saddles - Red brass, bronze, epoxy coated, or vinyl coated ductile iron body; stainless steel wide band strap, bolts, washers, and nuts.

3. Dual Wide Band Strap Saddles - Red brass, bronze, epoxy coated, or vinyl coated ductile iron body; two (2) stainless steel wide band straps, bolts, washers, and nuts.

4. Taps for steel pipe are not allowed unless specifically approved by the City.

5. Tapping saddle outlet shall be AWWA/CC standard thread.

B. Corporation Stops: NL Brass in compliance with AWWA C800 (latest revision).

1. Inlet: AWWA/CC standard thread.

2. Body: Tapered plug type, O-ring seat ball type, or rubber seated ball type.

3. Outlet End: CTS pack joint. Insert stiffeners required per manufacturer recommendations.

C. Service Tubing: High-Density Polyethylene (PE4710) SDR 9 tubing meeting Copper Tube Size (CTS) standards.

D. Curb Stops:

1. Inlet End: CTS pack joint. Insert stiffeners required per manufacturer recommendations.

2. Body: Straight-through, meter stop design equipped with the following:

a. O-ring seal straight plug type.

b. Rubber seat ball type.

3. Outlet End: Female, Iron Pipe threads of the same size as the service tubing diameter. Built in meter couplings/swivel-nut outlet ends are prohibited.

E. Fittings: NL brass in accordance with AWWA C800 and the following:

1. Castings: Smooth, free from burrs, scales, blisters, sand holes, and defects which would make them unfit for intended use.

2. Nuts: Smooth cast and have symmetrical hexagonal wrench flats.

3. Threaded Fittings: NPT or AWWA threads. Male threaded ends shall be protected in shipment by plastic coating or other equally satisfactory means.

4. Use same size open end wrenches and tapping machines as used with respective brand fittings.

5. Flange Fittings: Elliptical with female NPT threads for connection to 1-1/2” and 2” meters. Pack joint outlets shall be used for customer side service tubing connections.

6. Stamp of manufacturer’s name or trademark and fitting size on body.

7. Fittings to be by A.Y. McDonald, Ford, Cambridge Brass, or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. For service lines and lateral connections larger than those allowed in Pipe Tapping Schedule, branch connections and multiple taps may be used. Taps shall be spaces a minimum of 2-feet apart.

B. Use tapping machine manufactured for pressure tapping purposes for 2-inch and smaller service taps on pressurized water lines.

C. Locate water meter, meter box, and valve box as indicated on City Details 02665-01, 02665-02, and 02665-03. Deviation from City Details due to existing conflicts shall be approved by the City in writing prior to installation.

D. Successfully perform hydrostatic and disinfection testing prior to installation of service taps and lines.

3.02 TAPPING AND SERVICE LINE INSTALLATION

A. Set service taps at right angles to proposed meter location and locate taps in upper pipe segment within 45 degrees of pipe springline.

B. Separate taps and service leads are required for each domestic meter. Irrigation meters shall be branched off the domestic service line.

1. Tap size shall be a minimum of 2-inches for domestic services with irrigation meters.

C. Install service lines in accordance with Section 02227 – Excavation and Backfill for Utilities.

D. Lay service lines with a minimum of 6-inches of cover measured from the bottom of curb or 2-feet from top of curb, whichever is greater. For streets with roadside ditches, lay services lines with a minimum of 18-inches of cover measured from the ditch flowline.

E. Maintain service lines free of dirt and foreign matter during construction.

F. Install service lines above existing sanitary sewers. Anticipate existing sanitary sewer trenches to have cement stabilized backfill to the bottom of pavement. No additional payment for sanitary sewer crossings.

3.03 CURB STOP INSTALLATION

A. Set curb stops at the end of service lines inside the meter box as indicated on City Detail 02665-01 Typical Water Service for Meters 1-Inch and Under or 02665-02 Typical Water Service for 2-Inch Meters. Secure opening in curb stop to prevent dirt and debris from entering service line.

B. In close quarters, make S-curve in the field. Do not flatten or kink service tubing.

3.04 METER FITTING HOOKUP

A. Meter fitting hookup shall be as indicated on City Detail 02665-01 Typical Water Service for Meters 1-Inch and Under or 02665-02 Typical Water Service for 2-Inch Meters.

B. Support meter piping and meter, level and plumb, during installation.

C. Meters less than 1-inch: Install 1-inch x 3/4-inch reducing bushing and 3/4-inch straight meter coupling for connections to 5/8” or 3/4” meters.

D. 1-Inch Meters: Straight meter couplings shall be used for connections to 1-inch meters.

E. 1-1/2 and 2-Inch Meters: Elliptical flange fittings shall be used for connections to 1-1/2-inch and 2-inch meters.

3.05 METER BOX INSTALLATION

A. Install meter box over meter and fittings as indicated on City Detail 02665-01 Typical Water Service Meters 1-Inch and Under or 02665-02 Typical Water Service for 2-Inch Meters.

B. Install meter box lid flush with finished grade. Refer to Section 02604-01 Valve Boxes, Meter Boxes, and Meter Vaults for additional requirements.

END OF SECTION

SECTION 02675

DISINFECTION OF WATERLINES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Disinfection of potable waterlines.

1.02 UNIT PRICES

A. No payment will be made for disinfection of waterlines. Include cost in unit price of waterlines being disinfected.

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. All waterlines constructed shall be promptly disinfected before any tests are conducted on waterlines and before waterlines are connected to water distribution system.

B. Water for disinfection and flushing will be furnished without charge to Contractor.

3.02 PREPARATION

A. Furnish all required temporary blind flanges, cast-iron sleeves, plugs, and other items needed to facilitate disinfection of new mains prior to connecting them to water distribution system. Normally, each valved section of waterline requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for waterlines up to and including 6-inch diameter.

B. Fire hydrants shall be used as blow-offs to flush newly constructed waterlines 8-inch diameter and above. Where fire hydrants are not available on waterlines, install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.

C. Slowly fill each section of pipe with water in a manner approved by Owner’s Representative. Average water velocity when filling pipeline should be less than 1 fps and shall not, under any circumstance, exceed 2 fps. Before beginning disinfection operations, expel all air from pipeline.

D. All excavations made shall be backfilled immediately after installation of risers or blow-offs.

E. Install blow-off valves at end of main to facilitate flushing at all dead-end water mains. Install permanent blow-off valves as per drawing.

3.03 DISINFECTION

A. Use not less than 100 parts of chlorine per million parts of water. Introduce chlorinating material to water lines in accordance with AWWA C651. 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 parts of water. Open and close valves in lines being sterilized several times during contact period.

B. If a chemical compound is used for a sterilizing agent, it shall be placed in pipes as directed by Owner's Representative.

3.04 BACTERIOLOGICAL TESTING

A. After disinfection and flushing of waterlines, bacteriological tests will be performed by Owner or testing laboratory in accordance with Section 01410 - Testing Laboratory Services. If test results indicate need for additional disinfection of waterlines based upon Texas Department of Health requirements, Contractor shall perform additional disinfection operations at no additional cost to the Owner.

3.05 COMPLETION

A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

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 02811

LANDSCAPE IRRIGATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Pipe and fittings, valves, sprinkler heads and accessories.

B. Control system.

1.02 UNIT PRICES

A. Measurement and payment for Landscape Irrigation will be made under this Section on a lump sum basis.

1.03 SYSTEM DESCRIPTION

A. Electric solenoid controlled underground irrigation system.

B. Source Power: 120 volt

1.04 SUBMITTALS

A. Submittals shall conform to the requirements of all provisions and sections of these specifications.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in performing the work of this section with minimum three years documented experience.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for piping and component requirements.

1.07 PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this Section.

1.08 COORDINATION

A. Coordinate work under provisions of Section 02901 - Landscape Planting.

B. Coordinate the work with site landscape grading and delivery of plant life.

1.09 EXTRA MATERIALS

A. Furnish extra components under provisions of Bid Schedule.

1. Two sprinkler heads of each type and size.

2. Two valve box keys.

3. Two wrenches for each type head core and for removing and installing each type head.

PART 2 P R O D U C T S

2.01 PIPE MATERIALS

A. Pipe shall be continuously and permanently marked with Manufacturers name, size, schedules, type, and working pressure.

B. PVC Pipe ASTM D2411; 200 psi pressure rated upstream from controls, 160 psi downstream; solvent welded sockets rubber gasketed joints.

C. Fittings: Type and style of connection to match pipe.

D. Solvent Cement: ANSI/ASTM D2564 for PVC pipe and fittings.

E. Sleeve material: 4" schedule 40 PVC.

2.02 OUTLETS

A. Manufacturers or approved equal:

1. Rainbird Model 180 4.

2. Rainbird Model 1812

3. Hunder Model PGP

B. Rotary type sprinkler head: Pop-up type with screens; fully adjustable for flow and pressure; size as indicated; with letter or symbol designating degree of arc and arrow indicating center of spray pattern.

C. Spray Type Sprinkler Head: Pope-up head with full circle, half circle, third circle, quarter circle and square pattern.

2.03 VALVES

A. Manufacturers or approved equal:

1. Rainbird Model PEB Series

B. Gate Valves: Bronze construction, non-rising stem, and sized to line.

C. Backflow Preventers: FEBCO 765 Bronze body construction, reduced pressure zone or pressure vacuum braker type.

D. Valve Box and Cover: rectangular 10" x 14" or 9" round.

2.04 CONTROLLER

A. Manufacturers or approved equal:

1. Rainbird Model RC1260C

B. Valves: Electric solenoid wiring including required fittings and accessories.

C. Wire conductors: color-coded.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify site conditions under provisions of Section 01040 - Coordination and Meetings.

B. Verity location of existing utilities.

C. Verify that required utilities are available, in proper location, and ready for use.

3.02 PREPARATION

A. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover, and structures.

B. Layout and stake locations of system components.

C. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

3.03 TRENCHING

A. Trench and filling as required.

B. Trench size:

1. Minimum Cover Over Installed Supply Piping: 18 inches.

2. Minimum Cover Over Installed Branch Piping: 12 inches.

3. Minimum Cover Over Installed Outlet Piping: 12 inches.

C. Trench to accommodate grade changes.

D. Maintain trenches free of debris, material, or obstructions that may damage pipe.

E. Do not leave trenches open overnight.

3.04 INSTALLATION

A. Install pipe, valves, controls, and outlets in accordance with manufacturer's instructions.

B. Connect to utilities.

C. Set outlets and box covers at finish grade elevations.

D. Install control wiring as required. Provide 10-inch expansion coil at each valve to which controls are connected, and at 100 ft intervals. Bury wire beside pipe. Mark valves with neoprene valve markers containing locking device. Set valve markers in 160 psi PVC pipe risers exiting from top of valve to finish grade.

E. After piping is installed, but before outlets are installed and filling commences, open valves and flush system with full head of water.

F. Coordinate pipe installation with conduit installation.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed.

B. Prior to filling, test system for leakage for whole system to maintain 100 psi pressure for one hour.

3.06 FILLING

A. Provide 3 inch sand cover over piping. Fill trench and compact to subgrade elevation. Protect piping from displacement.

3.07 ADJUSTING

A. Adjust control system to achieve time cycles required.

B. Change and adjust head types for full water coverage as directed.

3.08 DEMONSTRATION

A. Provide system demonstration.

B. Instruct Owner's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance material as basis for demonstration.

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 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

1.1 SECTION INCLUDES

Structural concrete reinforcement and grouting of reinforcement dowel bars into hardened concrete.

1.2 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.

1.3 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.

1.4 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.

1.5 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

2.1 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.

2.2 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

3.1 PREPARATION

Clean reinforcement of scale, loose or flaky rust and other foreign material, including oil, mud or coating that will reduce bond to concrete.

3.2 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.

3.3 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 03305

CONCRETE FOR UTILITY CONSTRUCTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, cast-in-place manholes, inlets, headwalls and miscellaneous small structures.

1.02 UNIT PRICES

A. No payment will be made for concrete for utility construction under this Section unless specifically noted in bid documents. Include payment in applicable utility structure section.

1.03 SUBMITTALS

A. Conform to all provisions and sections of these specifications.

B. Submit proposed mix design and test data for each type and strength of concrete in the Work.

C. Submit laboratory reports prepared by an independent testing laboratory stating that materials used comply with the requirements of this Section.

D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by the Owner’s Representative.

E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.

F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details and other pertinent information.

G. For waterstops, submit product information sufficient to indicate compliance with specifications, including manufacturer's descriptive literature and specifications, when required on Drawings.

1.04 HANDLING AND STORAGE

A. Cement: Store cement off of the ground in a well-ventilated weatherproof building.

B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.

C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to the coating.

PART 2 P R O D U C T S

2.01 CONCRETE MATERIALS

A. Cementitious Material:

1. Portland cement: ASTM C150, Type II, unless the use of Type III is authorized by the Owner's Representative; or ASTM C595, Type IP. For concrete in contact with sewage use Type II cement.

2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in the form of $Na_2O + 0.658K_20$.

B. Water: Clean, free from harmful amounts of oils, acids, alkalis or other deleterious substances, and meeting requirements of ASTM C94.

C. Aggregate:

1. Coarse Aggregate: ASTM C33. Unless otherwise indicated, use the following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of the narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.

2. Fine Aggregate: ASTM C33.

3. Determine the potential reactivity of fine and coarse aggregate in accordance with the Appendix to ASTM C33.

D. Air Entraining Admixtures: ASTM C260.

E. Chemical Admixtures:

1. Water Reducers: ASTM C494, Type A.

2. Water Reducing Retarders: ASTM 494, Type D.

3. High Range Water Reducers (Superplasticizers): ASTM C494, Types F and G.

F. Prohibited Admixtures: Admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of 0.1 percent by weight of cement.

G. Reinforcing Steel:

1. Use new billet steel bars conforming to ASTM A615, ASTM A767, or ASTM A775, grade 40 or grade 60, as shown on Drawings. Use deformed bars except where smooth bars are specified. When placed in work, keep steel free of dirt, scale, loose or flaky rust, paint, oil or other harmful materials.

2. Where shown, use welded wire fabric with wire conforming to ASTM A185 or ASTM A884. Supply the gage and spacing shown, with longitudinal and transverse wires electrically welded together at points of intersection with welds strong enough not to be broken during handling or placing.

3. Wire: ASTM A82. Use 16-1/2 gage minimum for tie wire, unless otherwise indicated.

H. Fiber:

1. Polypropylene Fiber:

a. Ratio: 1.5 pounds of fiber per cubic yard of concrete.

b. Physical Properties:

(1). Material: Polypropylene.

(2). Length: 3/4 inch

(3). Specific Gravity: 0.9l.

(4). Absorption: None.

(5). Tensile Strength: 70-110 Ksi.

(6). Modulus of Elasticity: 500 Ksi.

(7). Melt Point: 140 degrees F (60 degrees C).

(8). Flash Point: 932 degrees F (500 degrees C).

(9). Density: 3 pounds/cubic yard.

c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.

I. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C309.

2.02 FORMWORK MATERIALS

A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair the finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2-inch (nominal) lumber or 3/4-inch form plywood backed adequately to prevent misalignment. General use: Provide lumber of 1-inch nominal thickness or form plywood of approved thickness.

B. Formwork for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4-inch minimum thickness, preferably oiled at the mill.

C. Chamfer Strips and Similar Moldings: Redwood, cypress or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.

D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.

E. Metal Forms: Clean and in good condition, free from dents and rust, grease or other foreign material that tend to disfigure or discolor concrete in a gage and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present a smooth surface and which line up properly.

2.03 PRODUCTION METHODS

A. Use either ready-mixed concrete conforming to requirements of ASTM C94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C685.

2.04 MEASUREMENT OF MATERIALS

A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C685.

B. Measure water and liquid admixtures by volume.

2.05 DESIGN MIX

A. Use design mixes prepared by a certified testing laboratory in accordance with ASTM C1077 and conforming to requirements of this section.

B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to the Owner's Representative for review.

C. Proportioning on the basis of field experience or trial mixtures in accordance with the requirements at Section 5.3 of ACI 318 may be used, if approved by the Owner's Representative.

D. Classification, unless shown otherwise on plans:

		Minimum Compressive Strength (Lbs/sq. in.)		Maximum W/C	Air Content	Consistency Range in Slump
Class	Type	7-Day	28-Day	Ratio (Percent)	(Percent)	(Inches)
A	Structural	3200	4000	0.45	4 +/- 1%	2 to 4*
B	Pipe Block Fill,					
	Thrust Block	----	2500	----	4 +/- 1%	5 to 7

* When ASTM C494, Type F or TYPE G admixture is used to increase workability, this range may be 6 to 9.

** Construction drawings govern

E. Add polypropylene fibers only when called for on the Drawings or in another section of these Specifications.

F. Determine air content in accordance with ASTM C138, ASTM C173 or ASTM C231.

G. Use of Concrete Classes: Use classes of concrete as indicated on the drawings and other specifications. Use Class B for un-reinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, and concrete fill unless indicated otherwise. Use Class A for all other applications.

2.06 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.

2.07 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: 1 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 FORMS AND SHORING

A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within the tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate cleanout openings. Before placing concrete, remove extraneous matter from within forms.

B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.

C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.

D. Back formwork with a sufficient number of studs and wales to prevent deflection.

E. Re-oil or lacquer the liner on the job before using. Facing may be constructed of 3/4-inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.

F. Unless otherwise indicated, form outside corners and edges with triangular 3/4-inch chamfer strips (measured on sides).

G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.

H. Treat facing of forms with approved form coating before concrete is placed. When directed by the Owner’s Representative, treat both sides of face forms with coating.

Apply coating before reinforcement is placed. Immediately before the concrete is placed, wet surface of forms which will come in contact with concrete.

3.02 PLACING REINFORCEMENT

A. Place reinforcing steel accurately in accordance with approved Drawings. Secure steel adequately in position in forms to prevent misalignment. Maintain reinforcing steel in place using approved concrete and hot-dip galvanized metal chairs and spacers. Place reinforcing steel in accordance with CRSI Publication "Placing Reinforcing Bars." Request inspection of reinforcing steel by the Owner's Representative and obtain acceptance before concrete is placed.

B. Minimum spacing center-to-center of parallel bars: 2-1/2 times nominal bar diameter. Minimum cover measured from surface of concrete to face of reinforcing bar unless shown otherwise on the Drawings: 3 inches for surfaces cast against soil or subgrade, 2 inches for other surfaces.

C. Detail bars in accordance with ACI 315. Fabricate reinforcing steel in accordance with CRSI Publication MSP-1, "Manual of Standard Practice." Bend reinforcing steel to required shape while steel is cold. Excessive irregularities in bending will be cause for rejection.

D. Do not splice bars without written approval of the Owner's Representative. Approved bar bending schedules or placing drawings constitute written approval. Splice and development length of bars shall conform to ACI 318, Chapters 7 and 12, and as shown on Drawings. Stagger splices or locate at points of low tensile stress.

3.03 EMBEDDED ITEMS

A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping and other embedded items in forms.

B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

3.04 BATCHING, MIXING AND DELIVERY OF CONCRETE

A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C94, Sections 8 through 11. Produce ready-mixed concrete using an automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.

B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C685, Sections 6 though 8.

C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of the Owner's Representative before adjustment and change of mix proportions.

D. Ready-mixed concrete delivered to the site shall be accompanied by batch tickets providing the information required by ASTM C94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing the information required by ASTM C685, Section 14.

E. Clean, maintain and operate equipment so that it thoroughly mixes material as required.

F. Hand-mix only when approved by the Owner's Representative.

3.05 PLACING CONCRETE

A. Give sufficient advance notice to the Owner's Representative (at least 24 hours prior to commencement of Operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to the Owner's Representative's approval.

B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, if necessary to continue after daylight hours, light the site as required. If rainfall occurs after placing operations are started, provide covering to protect the Work.

C. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not place concrete when the air temperature is at or below 40 degrees F and falling. Concrete may be placed 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.

D. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.

E. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken on initial set; do not place any strain on projecting reinforcement or anchor bolts.

F. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.

G. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.

H. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for the size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move the vibrator vertically through the layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.

I. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.06 WATERSTOPS

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.

C. Splicing PVC Waterstops:

1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.

2. Butt end-to-end joints of 2 identical waterstop sections may be made in the forms during placement of waterstop material.

3. Prior to placement in formwork, prefabricate all waterstop joints involving more than two ends to be joined together, an angle cut, an alignment change,

or the joining of two 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. Setting PVC Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete and to prevent folding over of the waterstop by concrete placement. 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. 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.

E. 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 the Contract Documents.

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:

a. 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.

b. 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.

c. 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.

d. 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.

e. 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.

7. 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.

3.07 CONSTRUCTION JOINTS

A. Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.

2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of the Owner's Representative. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.

B. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

3.08 CURING

A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for a period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from the concrete surface after placing and finishing. A curing day is any calendar day in which the temperature is above 50 degrees F for at least 19 hours. Colder days may be counted if air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at the end of calendar days equal to twice the required number of curing days. However, leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Owner's Representative.

B. Cure formed surfaces not requiring rub-finished surface by leaving forms in place for the full curing period. Keep wood forms wet during the curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.

C. Rubbed Finish:

1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging the surface.

2. After rub-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.

D. Unformed Surfaces: Cure by membrane curing compound method.

1. After concrete has received a final finish and surplus water sheen has disappeared, immediately seal surface with a uniform coating of approved curing compound, applied at the rate of coverage recommended by manufacturer or as directed by the Owner's Representative. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of the compound.

2. Thoroughly agitate the compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.

3. Do not apply compound to a dry surface. If concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or if rain falls on a newly coated surface before film has dried sufficiently to resist damage, apply an additional coat of compound at the specified rate of coverage.

3.09 REMOVAL OF FORMS AND SHORING

A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rub-finish when concrete has aged for the required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement,

B. Leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Owner's Representative.

3.10 DEFECTIVE WORK

A. Immediately repair any defective work discovered after forms have been removed. If concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace the entire section.

3.11 FINISHING

A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use a stiff mixture and thoroughly tamp into

place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with the surface.

B. Apply a rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet the surface with a brush and perform first surface rubbing with No. 16 carborundum stone or equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce a smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or equal. After rubbing, allow paste on the surface to reset; then wash surface with clean water. Leave structure with a clean, neat and uniform-appearing finish.

C. Apply a wood float finish to concrete slabs.

3.12 FIELD QUALITY CONTROL

A. Testing shall be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Unless otherwise directed by the Owner's Representative, the following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by an approved independent testing agency, and conform to the requirements of ASTM C1077.

1. Take concrete samples in accordance with ASTM C172.

2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test the specimens in accordance with ASTM C31 and ASTM C39.

3. When taking compression test specimens, test each sample for slump according to ASTM C143, for temperature according to ASTM C1064, for air content according to ASTM C231, and for unit weight according to ASTM C138.

4. Inspect, sample and test concrete in accordance with ASTM C94, Section 13, 14 and 15, and ACI 311-5R.

C. Test Cores: Conform to ASTM C42.

D. Testing High Early Strength Concrete: When Type III cement is used in concrete, the specified 7-day and 28-day compressive strengths shall be applicable at 3 and 7 days, respectively.

E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. If additional curing fails to produce the required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by the Owner's Representative, at no additional cost to the Owner.

3.13 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 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 03400

Prestressed Concrete Poles

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. This specification is to establish design and quality standards for static cast concrete poles for power distribution, lighting, and security mounting equipment

D. All pole design structural calculations shall be prepared by a licensed engineer experienced in prestressed concrete design and wind loading calculations

1.02 PRICE AND PAYMENT PROCEDURES

A. Items inclusive of the requirements of this section are to be included in the bid price. Item may be part of general electrical work or standalone bid item. This item will be paid on a fixed price basis for all related equipment as shown on contract drawings, located within the project limits of construction, and specified herein. Fixed price shall include poles, foundation, grounding, light fixtures, electronic enclosures, and all other accessories as shown in the contract documents

1.03 REFERENCES

A. Refer to other technical specifications for this project including:

1. 13100 – Lightning Protection
2. 16050 – Basic Electric Materials and Methods
3. 16051 – Basic Electrical Submittal and O&M Requirements
4. 16060 – Grounding and Bonding
5. 16211 – Electrical Utility Service

B. Not all references may be shown. Refer to other technical specifications in section 1.03 (A)

C. Relevant references may include all shown below:

1. National Electrical Code (NEC)
2. Underwriters Laboratories (UL)
3. National Fire Protection Association (NFPA) 70E – “Standards for safety in the workplace”
4. American National Standard Institute (ANSI)

5. Institute of Electrical and Electronic Engineers (IEEE)
6. ACI-318 – Building Code Requirements for Structural Concrete
7. ASCE-7 – Minimum Design Loads for Buildings and Other Structures
8. 2018 – International Building Code (IBC)
9. PCI Design Handbook – Precast/Prestressed Concrete Institute
10. Prestressed Concrete Institute – Guide for Design of Prestressed Concrete Poles
11. Concrete Reinforcing Institute – Manual of Standard Practice
12. American Society for Testing Materials (ASTM)
    a. C105 – Portland Cement
    b. C150 – Standard Specification for Type I and Type II Low Alkali Portland Cement
    c. C33 – Standard Specification for Concrete Aggregates
    d. C330 - Aggregates
    e. C494 - Admixtures
    f. A36 – Standard Specification for Carbon Structural Steel
    g. A82 – Cold Drawn Spiral Wire
    h. A416 – Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete (270K)
    i. A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
    j. A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

1.04 SUBMITTALS

A. Refer to referenced specifications for Basic Submittal and O&M Requirements

B. Concrete pole structural calculations, wind load calculations, and installation recommendations shall be prepared and sealed by licensed engineer as part of this work

C. Furnish detailed design drawing and computations for the pole supplied, including, but not limited to the following for review:

1. Calculated weight of each concrete pole
2. Center of gravity of each pole
3. Calculations of cracking and ultimate moment capacities at not more than 5-foot intervals
4. Dunnage and pickup points, including both one-point and two-point pickup locations

5. Detail of cross section and all points where reinforcing changes.
6. Section and strength properties including the ultimate
7. Cracking and zero tension moments and deflections at maximum 5-foot intervals along the pole.
8. Pole diameter at top, bottom, and ground line
9. Tip and butt wall thickness
10. Pre-stress strand; quantity, size, and dropout location
11. 28-day compressive strength of concrete
12. Diameter taper (inch/feet)
13. Installation depth and direct embedment recommendations
14. Wind loading calculations
15. Warranty certificates
16. Testing reports

PART 2. PRODUCTS

2.01 PRESTRESSED CONCRETE POLE

A. Standard class prestressed concrete poles suitable for direct embedment into the ground without special foundations shall be provided. Provide shall be one (1) piece construction and have access handholes in wall

B. Pole shall be provided with PVC conduit cast in pole to allow for installation of conductors and cables as specified in plan drawings

C. Wind loading strength: 150 mph and 1.3 gust factor for total support assembly, pole, supports, and attached appurtenances at indicated height above grade

D. Concrete pole structural calculations, wind load calculations, and installation recommendations shall be prepared and sealed

E. Poles shall be supported and protected during site storage, lifting and setting to prevent damage to the pole. Spalls or other damage incurred during these operations shall be repaired to restore the pole to “as new” condition

2.02 PHYSICAL CHARACTERISTICS

A. Shape and Length: Poles shall be square in cross-section, with chamfered corners, and shall have a standard taper of 0.162 inch per foot. Cross-sectional dimensions shall not deviate by more than 3/8 inch. The allowable tolerance for overall length shall be plus 3 inches and minus 2 inches. The width of the bottom face of the pole may be less than the top face

B. Finish: The pole shall have a smooth uncolored finish with no cracks. The top surface of each pole shall be troweled until all projections, depressions, and

irregularities have been removed and the entire surface has a smooth texture and neat lines. Square corners and sharp edges shall be tooled to form smooth, chamfered corners. All small cavities shall be cleaned, saturated with water, and then filled with mortar. A small cavity is defined as one larger than ¼ inch but smaller than ¾ inch in diameter, and less than 3/8 inch deep. Larger non-structural cavities and spalls shall be repaired by opening the side of the damaged area on a 1 to 1 slope using a mechanical grinder, cleaning thoroughly and filling with a high strength non-shrink concrete repair material. Poles with other defects may be repaired only upon authorization of, and using the method prescribed by the Design Engineer

C. Sealing Steel Strands: The end of each steel reinforcing strand (in the top and butt) shall be burned back to a minimum depth of ½ inch. The holes left by the removal of the strand shall be thoroughly cleaned of any loose residue. The holes shall then be filled with non-shrink grout and smoothed evenly with tip or butt surface

D. Cover: The prestressing strands shall have a minimum concrete cover of 1 inch, except that Type I poles will have a minimum cover of ¾ inch. The centerline axis along the faces of the poles shall be clear of embedded steel except for stirrups, spiral reinforcement and fabrication devices, so that ¾-inch diameter holes may be drilled without interference from the strands

E. Sweep: Sweep is the deviation of a pole from straightness. A straight line joining the edge of the pole at the butt and the edge of the pole at the top shall not be distant from the surface of the pole at any point by more than 3/8 inch for each 10 feet of length

F. Hole Drilling: Poles shall be drilled in accordance with approved drawings. The location of holes shall not deviate by more than 3/8 inch. Holes drilled after removal from molds shall be drilled from both sides of the pole and shall be uniform in entrance and exit. Holes drilled from opposing sides of the pole must be in the same plane and be centered on both faces

G. Cable Entrances: Two (2) cable entrances with couplings shall be cast in all 90 degrees to the handhole unless otherwise specified. Refer to plans for additional requirements

H. Handhole: Provide handhole with metal cover plate to act as junction box for conductor installations

2.03 STRENGTH REQUIREMENTS

A. Poles of each standard type, unless otherwise specified, shall be designed to withstand the rated design (cracking) and ultimate strength, with modifications to accommodate allowances for handling, transportation, and erection. The rated strength is that load which, if applied, in a direction perpendicular to the axis 2 feet below the pole tip and with the bottom of the pole (10 percent of its length plus 2 feet from the butt) held firm, will produce the first sign of hairline cracks. The ultimate strength is the load at which point failure occurs

B. All poles shall be capable of withstanding single point pickup from the horizontal position when lifting from a point 30 percent of the overall length down from the tip

2.04 MATERIALS

A. Chloride content: The chloride content of the concrete mix, including all ingredients, shall be 0.4 pounds per cubic yard, or less

B. Corrosion resistance: All inserts or attachments, if required, shall be of non-corrosive material or galvanized

C. Concrete: Concrete used in poles shall have a compressive strength at transfer of not less than 4,000 PSI, and a 28-day compressive strength of not less than 7,000 PSI, unless otherwise specified

PART 3. EXECUTION

3.01 QUALIFIED MANUFACTURERS

A. Lonestar Prestress Manufacturing Inc.

B. Or approved equal

3.02 INSTALLATION

A. Set units plumb, square, level, and secure according to manufacturer's written instructions and approved submittals

B. Poles shall be supported and protected during site storage, lifting and setting to prevent damage to pole. Spalls or other damage incurred during these operations shall be repaired to restore the pole to "as new" condition

3.03 HANDLING AND INSTALLATION PROCEDURES

A. Handling instructions:

1. Prestressed concrete poles will withstand a considerable amount of bending but should not be shock loaded while under load
2. Prestressed concrete poles should never be handled or picked up by the tip
3. When shipping poles, the poles should be supported at a minimum of three points for poles up to and including 40-feet and four points for poles over 40-feet
4. Poles up to 50 feet in length may be unloaded using a one-point pickup at the balance point but should never be transported in this manner. A two-point pickup must be used to transport a pole at the job site

B. Contractor will be responsible for conducting his own geotechnical investigation during the construction phase to finalize the foundation design

C. Installation procedure:

1. Prior to installation of the pole, electrical wiring, luminaries, and equipment brackets can be installed while the pole is lying horizontally on the ground
2. Excavate the proper diameter and depth hole per foundation show on drawings. Install reinforcing steel as shown on drawings, and pour foundation as appropriate during pole setting activities
3. To install, choke the pole with one end of a nylon sling 25 percent to 30 percent of the pole length from the top (see "Handling Instructions" paragraph for location). Attach the other end of the sling to the lifting hook of the crane
4. Lift the pole allowing the butt to rest on the ground until vertical
5. Lift the pole over foundation and lower until butt rests on foundation
6. While holding the pole, foundation pour around base of pole. Check for plumbness throughout the backfilling process
7. If the pole is equipped for an underground connection, stop backfilling to a point 6-inches below the connection. Make the connection and then finish backfilling the hole to a point 2-inches above grade.

3.04 DIRECT EMBEDMENT

A. Direct embedment is the most common and recommended method of installation of prestressed concrete poles. Soil conditions vary from location to location and should be investigated by an Engineer prior to designing the foundation. The "rule of thumb" for the depth of embedment is 10 percent of the overall length plus 2 feet. Depending upon the type of soil, an appropriate backfill should be selected. The chart below contains suggested guidelines for the selection of backfill:

1. Good Soil: Compacted well graded sand and gravel, hard clay or well graded fine and coarse sand. The excavated soil may be used as the backfill
2. Medium Soil: Compacted fine sand and clay, compact sandy loam, loose coarse sand and gravel. Requires select backfill. Clean, washed sand or minus ½ inch well graded gravel may be used
3. Poor Soil: Soft clay, clay loam, poorly compacted sand or clays containing large amounts of silt. Requires one of the following: cementitious earth, cement stabilized sand, limestone screenings or urethane foam

3.05 GROUNDING

A. Refer to grounding specification for additional requirements

B. A PVC conduit to pull ground wire through may be cast in pole if required

3.06 SITE QUALITY CONTROL

A. Inspect installed units for damage

B. Replace or repair damaged poles

C. Tests shall be made, and records shall be maintained, in accordance with the requirements of prestressed concrete institute MNL-116, “Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products”

END OF SECTION

SECTION 03411

STRUCTURAL PRECAST CONCRETE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Precast concrete for wet wells, junction structures, valve vaults, and meter vaults as shown on the Drawings. Also includes supporting and connecting devices necessary for proper installation and embedded items shown on the Drawings.

1.02 DESIGN REQUIREMENTS

A. Design structural precast concrete members in accordance with ACI 350R.

B. For members exposed to weather, design for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic, day/night temperature ranges.

C. Design system to accommodate construction tolerances, deflection of other building structural members, and clearances of intended openings.

1.03 SUBMITTALS

A. Conform to all provisions and sections of these specifications.

B. Shop Drawings: Indicate layout, unit locations, fabrication details, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials and design calculations signed and sealed by a Professional Structural Engineer licensed in the State of Texas.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with the requirements of PCI MNL-116 and ACI 301.

1.05 QUALIFICATIONS

A. Fabricator: Company specializing in manufacturing precast concrete components with minimum 5 years documented experience.

B. Erector: Company specializing in erecting precast concrete components with 5 years documented experience and approved by manufacturer.

C. Welder: Qualified within previous 12 months in accordance with AWS D1.1 and AWS 1.4.

D. Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of structural precast concrete components and licensed in the State of Texas.

1.06 REGULATORY REQUIREMENTS

A. Conform to ACI 318 and ACI 350R for design load and construction requirements applicable to work of this section.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver, store, protect, and handle products at the site under provisions of Section 01500 - Temporary Facilities and Controls.

B. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

C. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

D. Protect members to prevent staining, chipping, or spalling of concrete.

E. Mark each member with date of production and final position in structure.

PART 2 P R O D U C T S

2.01 CEMENT, GRAY PORTLAND, CONFORMING TO ASTM C 150 TYPE II.

A. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116 and Section 03310 - Structural Concrete.

2.02 REINFORCEMENT

A. Reinforcing Steel: ASTM A 615 Grade 60, deformed steel bars.

B. Welded Steel Wire Fabric: ASTM A 497 Welded Deformed Type; in flat sheets; unfinished.

2.03 ACCESSORIES

A. Connecting and Supporting Devices: ASTM A 666 stainless steel plates, angles, items cast into concrete.

B. Grout: Non-shrink, non-metallic, minimum compressive strength of 7000 psi at 28 days conforming to Section 03600 - Structural Grout.

2.04 FABRICATION

A. Fabrication procedure to conform to PCI MNL-116 and ACI 318.

B. Maintain plant records and quality control program during production of precast members. Make records available upon request.

C. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

D. Provide required openings with a dimension larger than 10 inches and embed accessories, provided by other Sections, at indicated locations.

2.05 FINISHES

A. Finish members to PCI MNL-116 Commercial Finish A grade.

2.06 FABRICATION TOLERANCES

A. Conform to PCI MNL-116.

B. Maximum Out-of-Square: 1/8 inch/10 feet, non-cumulative.

C. Maximum Out of-Round: 1/8 inch/10 feet diameter, non-cumulative.

D. Maximum Misalignment of Anchors, Inserts, Openings: 1/8 inch.

2.07 SOURCE QUALITY CONTROL AND TESTS

A. Test samples in accordance with applicable ASTM standard and as required by Section 03310 - Structural Concrete.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and field measurements are as shown as on shop drawings.

3.02 PREPARATION

A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

B. Prepare a means of protection of PVC liner and embeds from damage during construction, transportation, and erection.

3.03 ERECTION

A. Erect members without damage to structural capacity, shape or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and vertical joints, as erection progresses.

C. Provide continuous resilient waterstop or ASTM C 443 rubber gasket to obtain watertight joint between precast units.

D. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.

E. Grout joints between precast units before caisson sinking proceeds.

F. Secure units in place with connection plates before caisson sinking proceeds.

G. Perform welding in accordance with AWS D1.1.

3.04 ERECTION TOLERANCES

A. Erect members level and plumb within allowable tolerances.

B. Conform to PCI MNL-116.

3.05 PROTECTION

A. Protect members from damage caused by field welding or erection operations.

B. Provide non-combustible shields during welding operations.

3.06 CLEANING

A. Clean weld marks, dirt, or blemishes from surface of exposed members.

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 03700

CONCRETE REPAIR AND REHABILITATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Repair of cracks, holes and surface defects, and repair of deteriorated concrete surfaces.

B. Installation of embedded items into existing concrete.

1.02 UNIT PRICES

A. Measurement for repair materials is on a lump-sum basis for each structure as bid. Payment includes work performed on these structures in accordance with related sections included in the Contract Documents.

B. Measurement for extra removal of deteriorated concrete and placement of repair mortar is on a cubic-foot basis. Measurement for other repair materials is as defined in the appropriate related sections. Payment includes associated work performed in accordance with related sections included in the Contract Documents.

1.03 SUBMITTALS

A. Submittals shall conform to all provisions and sections of these specifications. Submit manufacturer's product information, installation instructions and recommendations, and certification of compliance with required properties for all repair materials.

1.04 REPAIR SCOPE

A. Patch and fill openings in existing concrete indicated to be patched or filled.

B. Patch, fill holes in and otherwise repair damage to concrete and concrete surfaces resulting from removal of penetrating pipes and other embedded items, from installation of pipes or other items embedded in or passed through concrete, and from other construction activities.

C. Crack Repair: Repair the full length of cracks in concrete members in new structures, and in existing structures as follows:

D. Deteriorated Concrete:

1. Repair interior concrete surfaces showing signs of deterioration in the following existing structures:

2. The level of deterioration of the concrete varies within each of the listed structures.

1.05 QUALITY ASSURANCE

A. Field Tests of Cement-based Grouts:

1. Compression test specimens will be prepared during construction by the Owner's Representative, or Owner's Representative's authorized representative, from the first placement of each type of mortar or grout, and at intervals thereafter as determined by the Owner's Representative, to ensure continued compliance with these specifications.

2. Specimen preparation and compression testing for repair mortar and non-shrink grout will be performed as specified in ASTM C109. A set of three specimens will be made for testing at 7 days, 28 days, and additional testing as appropriate.

3. Material failing to meet Contract requirements is subject to removal, and replacement with new material meeting requirements, at no additional cost to the Owner.

4. Cost of laboratory tests on mortar and grout will be borne by the Owner, except Contractor shall pay for tests failed, and additional testing and investigation work performed because of work not meeting Contract requirements.

5. Contractor shall supply all materials necessary for fabricating test specimens and assist the Owner's Representative in obtaining specimens for testing.

B. Repair concrete shall be tested as required in Section 03310 - Structural Concrete.

C. Epoxy grout shall be tested as required in Section 03600 - Structural Grout.

D. Chemical Grout:

1. Installer: A waterproofing contractor with a minimum of 3 years experience in the installation of chemical grout systems as specified herein, and shall be certified or approved by the manufacturer.

2. Waterproofing contractor shall submit a list of 5 previous jobs successfully completed by that firm that successfully utilized the specified chemical grout system.

E. Construction Tolerances: As specified in Section 03100 - Concrete Formwork, and Section 03345 - Concrete Finishing, except as otherwise indicated.

PART 2 P R O D U C T S

2.01 REPAIR MORTAR

A. Repair Mortar: Prepackaged polymer-modified cement-based product specifically formulated for repair of surface defects in concrete, having the following properties:

Physical Property	Minimum Value	ASTM Standard
Compressive Strength		C109
1 day	2000 psi	
28 days	6000 psi	
Bond Strength		C882 (modified)
1 day	1200 psi	
7 days	2000 psi	

B. Manufacturer and Product: Emaco by Master Builders, SR93 by Euclid Chemical Company, Sikacem by Sika Corporation, Five Star Structural Concrete by Five Star Products, Inc., or equal. Where the manufacturer offers products in formulations intended for specific application conditions such as overhead and shotcrete application, use the formulation recommended by the manufacturer for the condition required.

C. Minimum Repair Thickness: 0.50 inch.

2.02 NON-SHRINK GROUT

A. Non-shrink Grout: Comply with requirements of Section 03600 - Structural Grout.

2.03 CONCRETE MATERIALS

A. Cement: Type II Portland cement, unless indicated otherwise. Where repairs are made on wall surfaces exposed to view and above normal water surface elevation, blend white Portland cement with Type II cement as needed to match the color of adjacent existing concrete surface.

B. Repair Concrete: Class A (4000 psi), (unless specified otherwise) concrete with one-inch maximum coarse aggregate, complying with Section 03310 - Structural Concrete; minimum repair thickness, 2 inches.

C. Cement Grout: Comply with Section 03600 - Structural Grout; minimum repair thickness, one inch.

D. Curing Materials, Bonding Agents and other Miscellaneous Materials: Comply with Section 03310 - Structural Concrete and Section 03370 - Concrete Curing.

2.04 AGGREGATE

A. Aggregate for Extending Repair Mortar and Non-shrink Grout Products: 3/8 inch clean, washed gravel or crushed stone complying with Section 03310 - Structural Concrete.

2.05 CHEMICAL GROUT

A. Chemical Grout: Hydrophobic urethane or polyurethane material of low viscosity suitable for pumped injection into cracks, which reacts with water to form a closed-cell foam material that completely fills and seals all cracks against leakage. Cured material shall remain elastic and maintain an expansive pressure through repeated wet-dry cycles.

B. Manufacturer and Product: Scotch Seal 5600 by the Adhesives, Coatings, and Sealers Division of 3M Products; Flex LV by De Neef America, Inc.; SikaFix by Sika Corporation; or equal. Use different formulations in the same family of materials, accelerators, and other materials necessary for installation where recommended by the manufacturer for specific application conditions.

C. Reacted and cured chemical grout shall be resistant to organic solvents, mild acids, alkali and microorganisms. Cured material shall be approved for use with potable water by the appropriate federal, state or local government agency.

2.06 EPOXY PRODUCTS

A. Epoxy Grout: Comply with Section 03600 - Structural Grout, modified as specified herein.

B. Epoxy for Crack Injection: ASTM C881, Type IV; low viscosity, moisture-insensitive material specifically formulated for that use; 2500 psi minimum bond strength when tested in accordance with ASTM C882 at 14 days, moist cured.

2.07 SEALANT

A. Sealant: 2-part polyurethane complying with Section 03250 - Joints in Concrete Structures.

2.08 FORMWORK

A. Formwork, Where Needed: Comply with Section 03100 - Concrete Formwork.

2.09 REINFORCEMENT

A. Reinforcement, Where Required: Comply with Section 03210 - Reinforcing Steel.

2.10 SILIENT WATERSTOP

A. Resilient Waterstop: Comply with Section 03250 - Joints in Concrete Structures.

PART 3 E X E C U T I O N

3.01 PREPARATION AND CURING

A. Where repairs are made on wall surfaces exposed to view and above normal water surface elevation, installed repair material shall match adjacent concrete surface in color.

B. Surface Preparation:

1. Clean entire area to be repaired of laitance, foreign material and loose or deteriorated concrete by chipping, hydroblasting or sandblasting; further roughen surfaces as specified herein. Where non-shrink grout or repair mortar is used, perform any additional surface preparation steps recommended by the manufacturer.

2. Where cementitious repair materials are used, maintain surfaces to be repaired in a saturated surface dry condition and prevent concrete from drying until repair operations are completed. Re-wet surfaces to be repaired by water spray on at least a daily basis. Remove standing water in areas to be repaired prior to placement of repair material. Provide means to remove excess water from the structure.

3. Where repair material manufacturer recommends use of an epoxy-bonding agent, follow recommendations of both the repair material and epoxy bonding agent manufacturers.

C. Fully consolidate repair material, completely filling all portions of areas to be filled.

D. Bring repair surfaces into alignment with adjacent existing surfaces to provide uniform, even surfaces. Unless indicated otherwise, repair surfaces shall match adjacent existing surfaces in texture and receive coatings or surface treatments provided for adjacent existing surfaces.

E. Curing:

1. Cure repair mortar and non-shrink grout according to manufacturer's recommendations, except that minimum cure period shall be 3 days.

2. Cure other materials in accordance with Section 03370 - Concrete Curing.

3. If manufacturer recommends use of a curing compound, use no material that would interfere with the bond of any coating or adhesive required to be applied to the surface.

3.02 TREATMENT OF SURFACE DEFECTS

A. Definition - Surface Defects: Depressions in concrete surfaces not extending all the way through a member, caused by physical damage, un-repaired rock pockets created during original placement, spalling due to corroded reinforcing steel or other embeds, or removal of embedded items or intersecting concrete members.

B. Preparation:

1. Remove loose, damaged concrete by chipping to sound material.

2. Where existing reinforcing bars are exposed, remove concrete at least one inch deep all around the exposed bars. If the existing bars are cut through, cracked, or cross-sectional area is reduced by more than 25 percent, notify the Owner's Representative immediately.

C. Repair Material:

1. Use only repair mortar to repair surface defects in members normally in contact with water or soil, and defects in interior surfaces of structures which are intended to contain water.

2. Repair of other surface defects may be by application of repair mortar, repair concrete or cement grout, as appropriate.

3.03 PATCHING OF HOLES IN CONCRETE

A. General:

1. Definition - Holes: For the purposes of this section, holes are defined as penetrations completely through a concrete member, with interior surfaces approximately perpendicular to the surface of the existing member. Chip interior surface areas which are inclined and do not meet this criterion as necessary to meet this requirement.

2. Perimeter of holes at the surface shall form a regular shape composed of curved or straight line segments. Provide at least the minimum placement depth specified for the material used at all locations. Score existing concrete by sawcutting and chip as needed to meet this requirement.

3. Roughen the interior surface of holes less than 12 inches in diameter to at least 0.125-inch amplitude. Roughen larger holes to at least 0.25-inch amplitude.

4. At holes not filled with repair mortar or non-shrink grout, and where otherwise recommended by the repair material manufacturer, coat existing surfaces to be repaired with epoxy bonding agent.

5. Where a surface of a member is exposed to view and the repair material cannot be adjusted to match the color of the existing concrete, hold back the repair material 2 inches from the surface. Fill the remaining 2 inches with color-adjusted cement grout. Roughen the surface of the repair material when placed to improve bond with the cement grout.

B. Patching Small Holes:

1. Fill holes less than 12 inches in least dimension and extending completely through concrete members with repair mortar or non-shrink grout.

2. Fill holes in members normally in contact with water or soil with Class I non-shrink grout in accordance with Section 03600 - Structural Grout.

C. Patching Large Holes:

1. Fill holes larger than 12 inches in least dimension with repair concrete, repair mortar or non-shrink grout.

2. Provide large holes normally in contact with water or soil and not filled with Class I non-shrink grout with resilient waterstop placed in a groove approximately 0.25 inch deep ground into the interior edge of the hole at the center of the wall providing a smooth surface in which to place the resilient waterstop. Alternatively, bond bentonite waterstop to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Install waterstop in accordance with Section 03250 - Joints in Concrete Structures.

3. Provide reinforcing steel in layers matching existing reinforcement locations, except provide concrete cover required by the Contract Documents for the applicable service condition.

4. For holes smaller than 48 inches, reinforcement shall be at least #5 bars on 12 inch centers in each layer required. At all holes larger than 30 inches, drill and grout the reinforcement into the existing concrete.

5. For holes larger than 48 inches, see the drawings for reinforcement details.

3.04 PATCHING OF LINED HOLES

A. These provisions apply to openings which have embedded material over all or a portion of the inside edge. Requirements for repairing holes in concrete specified above shall apply as modified herein. The Owner’s Representative will determine when the embedded material is allowed to remain.

B. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface. Roughen or abrade the embedded material to promote good bonding to the repair material. Completely remove any substance that interferes with good bonding.

C. Completely remove embedded items not securely and permanently anchored in the concrete.

D. Completely remove embedded items larger than 12 inches in least dimension unless composed of a metal to which reinforcing steel can be welded. Where reinforcement is required, weld it to the embedded metal.

E. Following additional requirements apply to concrete in contact with water or soil.

1. Fill lined openings less than 4 inches in least dimension with epoxy grout.

2. Coat lined openings greater than 4 inches but less than 12 inches in least dimension with an epoxy-bonding agent prior to filling with Class I non-shrink grout.

3. Coat lined openings greater than 12 inches in least dimension with an epoxy bonding agent and bond bentonite waterstop to the interior of the opening prior to filling with approved repair material.

3.05 INSTALLATION OF PIPES AND FRAMES

A. The following applies to installation of permanent pipes and frames in openings cut into existing concrete members.

B. Cut opening to a size which is a minimum of one inch and a maximum of 3 inches larger than the outside edge of the embedded item. At openings with sharp corners, take care not to sawcut beyond the opening so as to damage existing reinforcing bars. At openings which are greater than 24 inches in least dimension, chip a keyway into the center of the wall. Keyway shall be at least 1.5 inches in depth and from 3 inches to 1/3 the member thickness in width. All surfaces except at the keyway shall be perpendicular to the member surface as specified herein for patching holes.

C. Provide embedded items with a flange or other positive means of anchorage to repaired members. At members in contact with soil or water, provide continuous waterstop flanges around embeds. Where concrete pipe will be embedded, provide resilient waterstop around pipe at wall centerline.

D. Roughen the interior surface of openings to at least 1/4-inch amplitude. Sandblast the embed surface to be in contact with concrete clean to promote good bonding to the repair material.

E. Fill the space between the frame and the existing concrete with Class I non-shrink grout.

F. Where surface of a member is exposed to view and the repair material cannot be adjusted to match the color of the existing material, hold back the repair material 2 inches from the surface. Fill the remaining 2 inches with color-adjusted cement grout.

3.06 NON-FIXED INSTALLATION OF PIPES

A. The following applies to installation through existing concrete of piping to be sealed with adjustable linked seals, resilient connectors, or packing and sealant. When more appropriate, the Owner's Representative may require installation of a sleeve instead of the core-drilled hole specified herein.

B. Size core-drilled opening to permit installation of the required seal; locate to minimize cutting of existing reinforcing steel.

C. Where linked or resilient seals are to be installed, coat the interior surface of the opening with epoxy at least 1/8 inch thick for a smooth and even surface promoting a good seal.

D. Where packing and sealant are required, seal exposed reinforcing bars with at least an 1/8-inch thick layer of epoxy extending 1/2 inch beyond the bars on all sides. Prepare the surface of the cut concrete and the pipe as recommended by the sealant manufacturer.

3.07 GENERAL CRACK REPAIR

A. Repair cracks identified by the Owner's Representative as caused by shrinkage or thermal movement by injection with chemical grout as specified herein.

B. Repair cracks not caused by shrinkage or thermal movement by epoxy injection or as otherwise directed by the Owner's Representative.

3.08 CHEMICAL GROUT CRACK REPAIR

A. Inject chemical grout into all cracks as directed by the Owner's Representative in those structures included in the scope of work listed herein in accordance with the chemical grout manufacturer's installation instructions and recommendations.

B. Location of Injection Ports: Locate injection ports as recommended by the chemical grout manufacturer and as needed to insure complete penetration of the joint or crack with the grout. Spacing of injection ports shall not exceed 2 feet.

C. Drilling Ports: Drill holes for injection ports to the depth needed for proper distribution of the chemical grout. Take care to not damage any reinforcing steel.

D. Port preparation: Clean holes for injection ports of all debris and fit with an injection fitting as provided by the manufacturer of the chemical grout, or equal. Install injection fittings in accordance with manufacturer's instructions; allow fittings to

remain in place until chemical grout injection work is complete in that area. Install caps or valves at injection ports to prevent back flow of uncured chemical grout after it has been injected.

E. Chemical Grout Injection:

1. Follow instructions and recommendations of the chemical grout manufacturer and its representatives for chemical grout mixing and injection procedures.

2. Seal cracks at the surface where needed to assure complete penetration of injected chemical grout and prevent loss of material.

3. Prior to chemical grout injection, inject water into ports to provide water for the reaction process, flush out foreign matter and verify continuity between adjacent ports. Inject water into each port until it begins to flow from an adjacent or nearby port.

4. If the water injection procedure indicates the potential presence of voids within members or behind members resting against soil, notify the Owner's Representative immediately.

5. Beginning at the lowest injection port, inject chemical grout until the grout begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled. In general, port-to-port travel of the injection process will be from low to high in a continuous operation.

6. If port-to-port continuity does not occur at locations where continuity was verified through water injection, mark location and notify the Owner's Representative.

7. Avoid sudden application of high pressure during the injection process.

8. After completion of the grouting operation, remove all ports and surface sealing materials leaving an undamaged surface.

3.09 EPOXY CRACK REPAIR

A. Inject epoxy into all cracks in damaged concrete as indicated by the Owner's Representative in structures included in the scope of work listed herein. Follow installation instructions and recommendations of the epoxy manufacturer.

B. Inject cracks with sufficient pressure to ensure full penetration of epoxy but without causing further damage.

C. Location, drilling and preparation of ports for injection: As specified for chemical grout herein.

D. Epoxy Injection:

1. Follow instructions of the epoxy manufacturer and its representatives for all mixing and injection procedures.

2. Seal all cracks at the surface where needed to provide for complete penetration of the injected epoxy and to prevent loss of material.

3. Beginning at the lowest injection port, inject the epoxy until it begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled.

4. If port-to-port continuity does not occur, mark the location and notify the Owner's Representative.

5. Avoid sudden application of high pressure during the injection process.

6. After completion of injection operations, remove all ports and surface sealing materials to leave an undamaged surface.

3.10 REPAIR OF DETERIORATED CONCRETE

A. These provisions pertain to concrete damaged by abrasion, chemical attack or corrosion of reinforcing steel. The only material acceptable for surface repair is repair mortar as specified herein. Where the repaired surface is to be subsequently covered with a PVC liner or other protective material, coordinate finishing details with the liner material manufacturer.

B. Surface Preparation:

1. Remove loose, broken, softened and acid-contaminated concrete to sound, uncontaminated concrete.

2. Notify the Owner's Representative when removal of deteriorated concrete is complete. Schedule two weeks for the Owner's Representative to inspect the surface, perform testing for acid contamination, determine if additional concrete must be removed, and to develop any special repair details that may be needed. Should it be determined that additional concrete must be removed to reach sound, uncontaminated material, schedule another two-week period for further evaluation after completion of the additional removal.

3. Follow repair mortar manufacturer's instructions for additional surface preparation.

C. Repair Mortar Placement:

1. Follow manufacturer's recommendations for mixing and placement of repair mortar. After the initial mixing of the repair mortar, do not add additional water to change the consistency should the mix begin to stiffen.

2. Place repair mortar to the minimum thickness recommended by manufacturer but not less than 2 inch. Should there be areas where less than the minimum repair mortar depth of concrete is removed, Contractor may remove additional concrete to attain the minimum repair mortar thickness or may place repair mortar so as to increase the original thickness of the member. In any case, add repair mortar so that minimum cover over existing reinforcing steel is 2 inches. Do not place repair mortar so as to create locally raised areas. Where there is a transition with wall surfaces which are not in need of repair, do not feather the repair mortar at the transition. Sawcut a score line to not less than the minimum repair mortar depth and chip concrete out to it to form the transition. Take care not to cut or otherwise damage reinforcing steel.

3. Finish repair mortar in an even, uniform plane to restore the member to its original surface. Out-of-plane tolerance: No localized depressions or projections; 0.25 inch maximum gap between repair mortar surface and a 10-foot straight edge in any orientation at any location.

D. Finishing:

1. Apply a smooth magnesium float finish to repair mortar.

2. When completed: No sharp edges. Exterior corners, such as at penetrations: One-inch radius. Interior corners: Square, except 2-inch repair mortar fillet at corners to receive PVC lining.

END OF SECTION

SECTION 04220

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Miscellaneous masonry accessories.
6. Masonry-cell fill.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in concrete unit masonry.

C. Related Requirements:

1. Section 03100 "Concrete Formwork" for installing dovetail slots for masonry anchors.
2. Section 03210 "Reinforcing Steel" for steel reinforcing bars.

1.03 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).
B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: For the following:

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

C. Samples for Initial Selection:

1. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:

1. Exposed CMUs.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Material Certificates: For each type and size of the following:

1. Masonry units.
   a) Include material test reports substantiating compliance with requirements.
   b) For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Integral water repellant used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

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

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.
E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.
B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups as shown on the Architectural drawings.
2. As soon as the samples have been approved, deliver enough units to the job site to build:
   a) 6'-0" long x 6'-0" high by full thickness sample wall panel unless otherwise indicated in the Drawings.
   b) Provide sample of each type of exposed unit masonry including grey units, or Burnished units when used for specific projects, interior walls and each exterior wall system.

c) Include flashings, damp proofing, mortar net and weeps, caps, sills, insulation, sealant, etc.
d) Where windows are indicated in a CMU wall, install one min 12”x12” aluminum frame system
e) Build the panel using the mortar, reinforcing, tooling and cleaning as specified
f) Include face and backup wythes and accessories.
g) Include a sealant-filled joint at least 16 inches long in each mockup.

3. The approved sample panel shall be the standard of workmanship.
4. Panel shall not be removed until masonry work as required by this section has been accepted or as directed by the Architect.
5. Use sample panel to test cleaning methods.
6. Protect accepted mockups from the elements with weather-resistant membrane.
7. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a) Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   b) Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
8. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.09 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
B. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

1. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

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

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.02 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.

2.03 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

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

2.04 CONCRETE MASONRY UNITS

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

    1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
    2. Provide square-edged units for outside corners unless otherwise indicated.

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

    1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

C. CMUs: ASTM C90.

    1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi for Type S or Type M or Type N.
    2. Density Classification: Normal weight.
    3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
    4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
    5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.05 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:
B. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.
C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 03 2000 "Concrete Reinforcing," and with reinforcing bars indicated.

D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.06 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.
C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
D. Masonry Cement: ASTM C91/C91M.
E. Mortar Cement: ASTM C1329/C1329M.
F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
G. Colored Cement Products: Packaged blend made from portland cement and hydrated lime, masonry cement, or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:
2. Colored Masonry Cement:
3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
4. Pigments shall not exceed 10 percent of portland cement by weight.
5. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.

H. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C404.
J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

L. Water: Potable.

2.07 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.187-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet.

2.08 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.
B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 304 or Type 316.
4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 or Type 316.
7. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick steel sheet, galvanized after fabrication.
   a) 0.064-inch-thick, galvanized-steel sheet may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.
   a) 0.064-inch-thick, galvanized sheet may be used at interior walls unless otherwise indicated.

E. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTMA 153/A153M.

2.09 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.10 MORTAR AND GROUT MIXES

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

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

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

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type needed to provide required compressive strength of masonry.

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

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

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.
B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:

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

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

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

3.04 LAYING MASONRY WALLS

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

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

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

    1. Install compressible filler in joint between top of partition and underside of structure above.
    2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
    3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
    4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 8443 "Joint Firestopping."

3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

    1. Bed face shells in mortar and make head joints of depth equal to bed joints.
    2. Bed webs in mortar in all courses of piers, columns, and pilasters.
    3. Bed webs in mortar in grouted masonry, including starting course on footings.
    4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

    1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
    2. Wet joint surfaces thoroughly before applying mortar.

3. Rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
F. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.06 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
C. Provide continuity at wall intersections by using prefabricated T-shaped units.
D. Provide continuity at corners by using prefabricated L-shaped units.
E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.07 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.08 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.

4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.09 LINTELS

A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.
D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.
G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.
H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
I. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.12 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.
B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

    1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
    2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
    3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
    4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
    5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

    1. Crush masonry waste to less than 4 inches in each dimension.
    2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 2000 "Earth Moving."
    3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05500

METAL FABRICATION

PART 1 - GENERAL

1.01 SCOPE

A. This specification covers bolts, anchors, nuts, sleeves, concrete anchors, scheduled items,
B. and other miscellaneous metal items not specifically included under other sections of
C. these specifications.
D. The CONTRACTOR shall furnish all labor, materials, equipment, and incidentals
E. necessary to install and make ready all miscellaneous metal items as specified by the
F. Contract Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work performed under this Section.

1.03 REFERENCES

A. This specification references the following publications in their current editions:

1. ASTM A 36 – Structural Steel.
2. ASTM A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
3. ASTM A123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A276 – Stainless and Heat-Resisting Steel Bars and Shapes.
6. ASTM A307 – Carbon Steel Bolts and Studies, 60,000 psi Tensile Strength.
7. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
8. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
9. ASTM A501 – Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
10. ASTM F593 – Stainless Steel Bolts, Hex Cap Screws and Studs
11. ASTM F594 – Stainless Steel Nuts.
12. AWS A2.0 – Standard Welding Symbols
13. AWS D1.1 – Structural Welding Code.
14. SSPC – Steel Structures Painting Council.

1.04 QUALITY ASSURANCE:

1. Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Texas.
2. Welders' Certificates: Submit under provisions of Section 01300 – Submittals, certifying welders employed on the Work, Verifying AWS qualification within the previous 12 months.

B. SUBMITTALS:

1. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners and accessories. Include erection drawings, elevations, and details where applicable.
2. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.
3. Submit manufacturer's technical literature and test reports showing certified capacities for concrete anchors.

C. FIELD MEASUREMENTS:

1. Verify that field measurements are as indicated on the Contract Drawings.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Steel Shapes and Plate: ASTM A36.
B. Stainless Steel Sections: ASTM A276, Type 316 for non-welded items and Type 316L for welded items.
C. Steel Tubing: ASTM A500 or A501, Grade B.
D. Pipe: ASTM A53, Grade B Schedule 40
E. Bolts, Nuts and Washers: ASTM A307 galvanized to ASTM A153 for galvanized components, where specified or indicated on the Contract Drawings.
F. Bolts, Nuts and Washers: ASTM A325, Type III, High Strength Bolts for Structural Steel Joints.
G. Stainless Steel Bolts and Nuts: Bolts per ASTM F593, Type 316; nuts per ASTM F594, Type 316; UNC coarse threads, where specified or indicated on the Contract Drawings.
H. Concrete Anchors: Concrete anchors are inserted into holes drilled in hardened concrete and shall be one of the following types:

1. Adhesive Anchors: Concrete anchors which are submerged, in splash zones, in enclosed spaces over liquids, or anchoring vibrating equipment shall be epoxy adhesive anchors. Adhesive anchors may be used at all locations where concrete anchors are required. Epoxy systems shall be Sika/FI System with Sikadur Injection Gel Epoxy, Master Builders Concresive Paste LPL, or equal. Threaded rods shall be ASTM F593, Type 316 studs. Where adhesive anchors, or connected metal, are exposed to direct sunlight, the anchors shall be certified to maintain at least 90 percent of their rated strength (tested at 73 degrees F) when tested at 160 degrees F.
2. Expansion Anchors: Where concrete anchors are indicated and adhesive anchors are not required, wedge type anchors made with ASTM A276, Type 316 Stainless Steel shall be used. Anchors shall be KWIK Bolt II by Hillti, Inc. or approved equal.
3. Welding Materials: AWS D1.1; type required for materials being welded.

I. Shop and Touch-Up Primer: Compatible with systems specified in Sections 09871.

2.02 FABRICATION:

A. Fit and shop assemble in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FINISHES:

A. Prepare surfaces to be primed in accordance with SSPC SP2.
B. Do not prime surfaces in direct contact with concrete or where field welding is required.
C. Galvanize, after completion of welded fabrication, in accordance with ASTM A123, structural steel members. Provide minimum 1.25 oz/sq. ft. galvanized coating.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Verify that field conditions are acceptable and are ready to receive work.
B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION:

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply items required to be cast into concrete or embedded in masonry with setting
C. templates, to appropriate sections.
D. All stainless steel threads to be coated with an anti-seizing compound prior to installing nuts.

3.03 INSTALLATION:

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components indicated on shop drawings.
D. Perform field welding in accordance with AWS D1.1.
E. Obtain Engineer approval prior to site cutting or making adjustments not scheduled.
F. After erection, prime welds, abrasions, and surfaces not shop primed except surfaces to be in contact with concrete.

3.04 ERECTION TOLERANCES:

A. Maximum Variation from Plumb: ¼ inch per story, non-cumulative.
B. Maximum Offset from True Alignment: ¼ inch.

END OF SECTION

SECTION 08100

METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Provisions established within the Contractor Documents or City of Galveston Construction Standard Specifications are collectively applicable to this Section. Door hardware is included in Section 08710.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A 366 - Specification for Steel, Sheet, Carbon, Cold-rolled Sheet, Commercial Quality.

B. National Fire Protection Association (NFPA):
   1. NFPA 80-1983 Standard for Fire Doors and Windows
   2. NFPA 252, Fire Tests of Door Assemblies

C. Steel Door Institute (SDI):
   1. SDI-100 - Recommended Specification for Standard Steel Doors and Frames
   2. SDI-105 - Recommended Erection Instructions for Steel Frames
   3. SDI-107 - Hardware for Steel Doors (Reinforcement - Application).

D. Underwriters Laboratories, Inc. (UL):
   1. Building Materials List January 1990
   2. UL 10B -Fire Tests of Door Assemblies

E. Door Hardware Institute (DHI):
   1. The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.

1.03 QUALITY ASSURANCE

A. Provide doors and frames complying with the Steel Door Institute SDI 100 "Recommended Specifications for Standard Steel Doors and Frames."

B. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide fire—rated door and frame assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", and which have been tested, listed, and labeled in accordance with ASTM E 152 "Standard Methods of Fire Tests of Door Assemblies" by nationally recognized independent testing and inspection agency.

1.04 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300. Include details of frame type, details of construction, and details of joints and connections.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided the finish items are equal in all respects to new work and acceptable to the Owner; otherwise, remove and replace damaged items as directed.

B. Store doors and frames at building site under cover. Place units on minimum 4” high wood blocking.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide steel doors and frames as manufactured by one of the following:
Ceco Corp.
Curries Manufacturing, Inc.
Fenestra Corp.
Mesker Industries, Inc.
Republic Builders Products Corp.
Steelcraft

2.02 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

B. Cold—Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

C. Supports and Anchors: Fabricate of not less than 16 gage sheet steel.

D. Inserts, Bolts and Fasteners: Manufacturer’s standard units.

E. Shop-Applied Paint: For steel surfaces, use rust—inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.

2.03 STEEL DOORS

A. Provide full flush type steel doors of welded seamless construction with no visible seams or joints on faces. Comply with SDI—100 Grade II, heavy-duty, Model 1, minimum 18 gage faces.

1. At exterior doors, close top and bottom edges of doors flush as an integral part of door construction or by addition of minimum 0.0635-inch thick steel channels, with channel webs placed enven with top and bottom edges. Seal joints in top edges of doors against water penetration.

B. Transom Panels: Provide transom panels of same materials, construction, and finish as specified for doors.

C. Thermal—Rated (Insulating) Assemblies: Provide doors and transom panels which have been fabricated as thermal insulating panel and frame assemblies and tested in accordance with ASTM C 236. Provide thermal—rated assemblies with U factor of 0.24 Btu/(hr_ft2_°F.) or better.

D. Steel door must provide security window that is 5-inches wide and 26-inches in height.

2.04 STEEL FRAMES

A. Provide combination buck, frame, and trim type steel frames of 16 gage steel for doors, sidelights, and borrowed lights.

B. Fabricate frames of full-welded unit construction, with corners mitered, reinforced, continuously welded full depth and width of frame.

C. Rubber Door Silencers: Except on weatherstripped frames, drill stops to receive three silencers on strike jambs of single—door frames and two silencers on heads of double—door frames. Install plastic plugs to keep holes clear during construction. Upon completion of work, including painting of frames, install rubber door silencers (1229A by Trimco)

PART 3 - EXECUTION

3.01 INSTALLATION

A. Placing Frames: Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. Install at least three (3) wall anchors per jamb, as recommended by manufacturer for specific wall construction, at hinge and strike levels. Install fire-rated frames in accordance with NFPA Standard No. 80.

B. Door Installation: Fit hollow metal doors accurately in their respective frames, within clearances specified in SDI 100. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.02 ADJUST AND CLEAN

A. Final Adjustments: Check and readjust operating finish hardware items in steel door and frame work just prior to final inspection. Leave work in complete and proper operating condition.

B. Prime Coat Touch—Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch—up of compatible air- drying primer.

END OF SECTION

SECTION 08999

STEEL WATER STORAGE TANK REHABILITATION

PART 1 - GENERAL

1.01 SUMMARY

A. This section consists of the repair and replacement of pits, holes, corrosion damage, structural damage, and various improvements to the steel water storage tank and tank appurtenances.

1.02 SUBMITTALS

A. Submit shop drawings and product data according to specification section 01300.

1.03 REFERENCES:

A. American Water Works Association (AWWA)

1. AWWA D100-05 - Standard for Welded Steel Tanks for Water Storage
2. AWWA C-200 – Steel Water Pipe – 6 Inches and Larger

B. American Society for Testing and Materials (ASTM)

1. ASTM A36 - Structural Steel
2. ASTM A325 - Type 3, High strength Bolts for Structural Steel Joints
3. ASTM A442 - Pressure Vessel Plates, Carbon Steel, Improved Transition Properties
4. ASTM A516 - Pressure Vessel Plates, Carbon Steel, for Moderate – and Lower-Temperature Service
5. ASTM A517 - Pressure Vessel Plates, Alloy Steel, High Strength, Quenched and Tempered
6. ASTM A537 - Pressure Vessel Plates, Heated Treated, Carbon-manganese-Silicon Steel
7. ASTM A563 - Type C3 and Dh3, Carbon and Alloy Steel Nuts
8. ASTM A573 - Structural Carbon Steel Plates of Improved Toughness
9. ASTM A580 - Stainless and Heat Resisting Steel Wire
10. ASTM A588 - High Strength Low Alloy Structural Steel
11. ASTM A633 - Normalized High Strength Low Alloy Structural Steel
12. ASTM A662 - Pressure Vessel Plates, Carbon-Manganese, for Moderate and Lower Temperature Service
13. ASTM A678 - Quenched and Tempered Carbon Steel Plates for Structural Applications
14. ASTM F436 - Hardened Steel Washers
15. ASTM F593 - Stainless Steel Bolts, Hex Cap Screws, and Studs
16. ASTM F594 - Stainless Steel Nuts

C. American Petroleum Institute (API)

1. API 650, 11th Edition (June 2007) - Welded Steel Tanks for Oil Storage
2. API 653, 4th Edition (April 2009) - Tank Inspection, Repair, Alteration, and Reconstruction

D. American Welding Society (AWS)

1. Publication D1.1 - Structural Welding Code, Steel

E. American National Standard Institute (ANSI)

1. ANSI A14.3 - Safety Code for Fixed Ladders

F. American Society of Civil ENGINEERs (ASCE)

1. ANSI/ASCE 7-05 - Minimum Design Loads for Buildings and Other Structures

G. Occupational Safety and Health Administration (OSHA)

1. Regulation 1910.23 - Guarding Floor and Wall Opening and Holes
2. Regulation 1910.27 - Fixed Ladders
3. Regulation 1926.1053 – Ladders

H. NACE International (NACE) Standard

1. SP0178-2007 - Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service

I. SUBMITTALS:

1. Welding Certification: Welding procedures and welding operators shall be qualified in accordance with AWWA D100.
2. Construction Drawing Submittals: Construction Drawings of all fabricated and new items shall be submitted to the Consultant for review in accordance with Section 01300.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. All structural components shall be fabricated from new ASTM A36 material.
B. All steel plates, shapes, and bars shall be fabricated from new ASTM A36, A442, A516, A537, A588, A633, A662, or A678 material if the tank is designed in accordance with Section 14 of the AWWA D100-05. All steel plates and shapes shall be free from any laminations that bring questions as to the structural integrity of the member. Laminations exposed on the surface or edges of the steel shall be repaired or the member replaced. The CONTRACTOR shall be responsible for ultrasonically or otherwise investigating the extent of sub-surface laminations to the satisfaction of the Consultant. Members found to have internal lamination shall be replaced in a timely manner at the expense of the CONTRACTOR.
C. All new steel pipe attached to the tank shall meet the requirements of AWWA C-200.
D. All Stainless steel bolts and nuts shall conform to conform to ASTM F593 and F594.
E. All screen material shall be made of Type 316, stainless steel wire conforming to ASTM A580.
F. All interior nuts and bolts below the high water line shall be of 316 stainless steel material. All bolts used for the interior roof structure shall be inorganic zinc coated.

2.02 ITEM A: EXTERIOR LADDER

A. Acceptable Products: Ladders: Galvanized ladders shall be provided on the tank exterior. The outside ladder shall have an OSHA-type cage. Provide and install an OSHA safety climbing rail system.

B. Provide and install any necessary temporary protective devices for compliance with Federal OSHA requirements, all state and local safety regulations, and safe working practices shall be furnished and maintained by the CONTRACTOR.
C. Provide and install safe climbing devices complying with 2.05 on all ladders.
D. Ladder side rails shall be a minimum 3/8-inch by 2-1/2-inch with a 16-inch clear spacing. Rungs shall be minimum 3/4-inch diameter, spaced at 12 inch centers and plug welded into holes drilled in the side rails. Tank ladders shall be provided with 1-in. diameter rungs and 1/2 in. x 2-in. side rails and shall be fully seal welded.
E. Provide rungs with Mebac slip-reducing coating or approved equal.
F. A safety extension shall be provided at the top of the ladder under hatch(s). The safety extension shall be a Ladder Up Safety Post as manufactured by Bilco or ENGINEER's approved equal. The post shall extend 42-inches above the top of the ladder and be constructed of hot dip galvanized steel. Mounting hardware shall be galvanized.
G. Pole or cable devices will not be accepted.
H. Rails shall be center mounted and extend from three (3) feet above the ladder bottom to the top of the ladder section.

2.03 LADDER SAFETY POST

A. Furnish and install where indicated on plans ladder safety post. The ladder safety post shall be pre-assembled from the manufacturer.

1. Performance characteristics: a. Tubular post shall lock automatically when fully extended. b. Safety post shall have controlled upward and downward movement. c. Release lever shall disengage the post to allow it to be returned to its lowered position. d. Post shall have adjustable mounting brackets to fit ladder rung spacing up to 14" on center and clamp brackets to accommodate ladder rungs up to 1-3/4" in diameter.
2. Post: Shall be manufactured of high strength square tubing. A pull up loop shall be provided at the upper end of the post to facilitate raising the post.
3. Material of construction: Shall be aluminum.
4. Balancing spring: A stainless steel spring balancing mechanism shall be provided to provide smooth, easy, controlled operation when raising and lowering the safety post.
5. Hardware: All mounting hardware shall be Type 316 stainless steel.
6. Finishes: Factory finish shall be mill finish aluminum.

2.04 SAFETY CLIMB SYSTEM

A. Safe Climbing system shall be TS Rigid Rail Ladder Climbing System manufactured by French Creek Production.
B. Provide and install three (3) trolleys with snap hooks shall be provided that are designed to be operated with the aluminum rail. A safety body harness with front and side rings shall be supplied for each trolley.
C. Provide the OWNER with two (2) harnesses for safety climb system.

2.05 ITEM B: EXTERIOR VENT

A. Acceptable Products: Always Safe Tank (AST) or approved equal

B. The existing center tank vent shall be removed and disposed of by the CONTRACTOR and CONTRACTOR supplied roof vent shall be installed to conform to the dimensions and installation details shown in the Plans.
C. Screens (16 mesh) are to be installed on all vents. Screens for all vents to be ANSI 316 Stainless Steel with 50 percent opening area.

2.06 ITEM C: SAMPLE TAP AND LEVEL GAUGE

A. Sample Tap Acceptable Products: Provide three-quarter inch (3/4") NPT sampling tap.
B. Water Level Indicator Acceptable Products: Provide Enardo #1610 or approved equal. Provided foot of water-type gauge, single scale. Face is to be minimum four-and-one-quarter inch (4-1/4") diameter, glycerine filled, sand cast aluminum alloy, phosphorbronze Bourdon tube, with one-quarter inch (1/4") NPT male lower back connection and isolating valve. Range shall be at least 0 to 20 psi, or 0 to 46 feet. Show tank level in feet.
C. Hose Bib: ¾" IPS, thread inlet brass.
D. Wall penetration: 1" Unitank assembly, galvanized, ¾" Weld-o-let, or approved equal.

2.07 ITEM F: RAFTER REPLACEMENT

A. Following initial brush-off blast cleaning, any rafters identified for replacement by the CONTRACTOR and authorized by the OWNER shall be replaced in accordance with AWWA D100.

2.08 SUPPLEMENTAL ITEM S1: EXTERIOR AND INTERIOR GRINDING

A. Any irregular surfaces identified by the CONTRACTOR and authorized by the OWNER, including but not limited to surface protrusions, burrs, fitting scars, weld spatter, corners, sharp edges, rough weld beads, and weld overlap shall be removed from all interior and exterior surfaces of the tank including but not limited to the tank columns, dry riser, tank shell, and tank roof. The objective of the grinding is to eliminate irregular surfaces and to provide a sufficiently smooth surface for the application of a uniform coating without pinholes, holidays, and/or voids.

2.09 SUPPLEMENTAL ITEM S2: SEAM WELDING

A. This item shall be for furnishing all labor, materials, tools, equipment and incidentals required for Seam Welding all areas of apparent seam deterioration. Work areas shall be initially abrasive blast cleaned, and any seam corrosion or undercut identified by the CONTRACTOR and authorized by the Field Inspector and Project Representative shall be repaired by arc-gouging and welding.

PART 3 - EXECUTION

3.01 REPAIRS AND ADDITIONS:

A. Construction Drawing Submittals: Construction Drawings of all fabricated and new items shall be submitted to the Consultant for review. Drawings submitted shall at a minimum include the following: Drawings of ladders, climb rails, handrails, vents, manholes, weir, and overflow piping.
B. Access: Existing manways shall be used for access to the interior of the tank. No door sheet will be allowed.

C. Verification: Existing tank dimensions are based on record drawing information as well as field observation. CONTRACTOR shall field verify all dimensions of proposed improvements prior to fabrication and notify ENGINEER if discrepancies exist.

3.02 WELD TESTING

A. All seal welds shall be mag-particle tested and butt seal welds shall be x-ray tested.

3.03 ADJUSTMENT

A. If access and operation of the equipment or its appurtenances do not meet the criteria, the Contractor will remedy the situation criteria, at the Contractor's expense.

END OF SECTION

SECTION 09871

PAINTING AND PROTECTIVE COATINGS FOR POTABLE WATER STORAGE TANKS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. This item will consist of repair and preparation of surfaces to be painted, application of interior and exterior paint systems, paint system materials and disinfection of surfaces which contact potable water.

1.02 REFERENCES:

A. The CONTRACTOR shall adhere to the latest Standards and Codes for work associated with Coating and Recoating as published by the following organizations. In the event that there is a conflict between these Specifications and the standards, and codes, these Specifications shall govern. The OWNER's decision shall be final as the interpretation and/or conflict between these Specifications and the referenced standards and codes.

1. The Society for Protective Coating's *Steel Structures Painting Manual* and specifications contained within shall be referred to as SSPC.

B. American Water Works Association Standards shall be referred to as AWWA.
C. American Society for the Testing of Materials standards and specifications shall be referred to as ASTM.
D. U.S. Environmental Protection Agency shall be referred to as EPA.
E. American National Standards Institute shall be referred to as ANSI.
F. National Sanitary Foundation shall be referred to as NSF.
G. Occupational Safety and Health Administration shall be referred to as OSHA.
H. Texas Commission on Environmental Quality shall be referred to as TCEQ.
I. National Association of Corrosion Engineers shall be referred to as NACE.
J. Code of Federal Regulations shall be designated as CFR.
K. Texas Administrative Code shall be designated as TAC

1.03 DEFINITIONS:

A. Interior surfaces include the underside of the roof plate, girders, rafters, columns, pipes, floor, appurtenances (including ladders), wall, inner surface of container, and the tank overflow and influent structures.
B. Exterior surfaces include the outside of the tank and appurtenances (including ladders).
C. Near White Blast Cleaning SSPC-SP10, NACE 2 is defined as; a surface from which all oil, grease, dirt, mill scale, rust corrosion products, oxides paint, or other foreign matter have been completely removed. Ninety-five percent of each unit area (9 square inches) of prepared surface shall be free of light shadows, light streaks, or stains left after removal of the items listed above.
D. Commercial Blast Cleaning SSPC-SP6, NACE 3 is defined as; a surface from which all oil, grease, dirt, mill scale, rust corrosion products, oxides paint, or other foreign matter have been completely removed. Two thirds of each unit area (9 square inches) of prepared surface

shall be free of light shadows, light streaks, or stains left after removal of the items listed above.

E. Brush-Off Blast Cleaning SSPC-SP7, NACE 4 is defined as; a surface free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating. Tightly adherent mill scale, rust, and coating may remain on the surface. Mill scale, rust and coating are considered tightly adherent if they cannot be removed by lifting with a dull putty knife after abrasive blast cleaning has been performed.

1.04 SYSTEM DESCRIPTION:

A. Surface Preparation: CONTRACTOR shall prepare all surfaces for painting in accordance with the SSPC Steel Structures Painting Manual except as amended herein. Initial interior surface preparation within the tank bowl shall conform to SSPC – SP7, "Brush-Off Blast Cleaning." The finished quality of the interior surface preparation within the tank bowl shall conform to SSPC - SP10, "Near White Blast Cleaning." The finished quality of the exterior surface preparation shall conform to SSPC - SP6, "Commercial Blast Cleaning." All surfaces other than those inside the tank shall be considered exterior surfaces.

B. Painting: All paint, primers and paint thinners, including primer for shop primed components, shall be from the same approved manufacturer. All coating systems shall be provided with contrasting colors so that subsequent coatings will be easily identified during the coating process.

C. All Paint shall conform to current state and federal regulations applicable to Volatile Organic Compounds (VOC's).

D. Base Inside Coating System: Shall conform to AWWA Standard D102 for Inside Coating System No. 2 (**ICS-2**), and AWWA C210 and be acceptable for Potable Water Service by the EPA. Minimum dry film thickness and total dry film thickness shall be per the manufacturer's recommendation and shall comply with the requirements of AWWA D102. Coating shall meet ANSI/NSF Standard 61 approval for potable water storage.

E. Base Outside Coating System: Shall have a minimum dry film thickness and total dry film thickness per the manufacturer's recommendation and shall comply with the requirements Outside Coating System No. 5 (**OCS-5**) of AWWA D102. Colors of each coat shall be selected by OWNER. Top coat shall be fade-resistant.

F. Alternate A Inside Coating System: Shall conform to AWWA Standard D102 for Inside Coating System No. 5 (**ICS-5**) and meet the requirements for the base system above.

G. Alternate A Outside Coating System: Shall conform to AWWA Standard D102 for Outside Coating System No. 6 (**OCS-6**) and meet the requirements for the base system above.

H. Alternate B Inside Coating System: Shall conform to AWWA Standard D102 for Inside Coating System No. 6 (**ICS-6**) and meet the requirements for the base system above.

I. Alternate B Outside Coating System: Shall conform to AWWA Standard D102 for Outside Coating System No. 4 (**OCS-4**) and meet the requirements for the base system above.

1.05 SHROUDING

A. The CONTRACTOR shall control emissions from abrasive blasting in accordance with 30 TAC, Rule 111.135 or Rule 111.137. The CONTRACTOR shall ensure that no spent cleaning/blasting debris, dust, overspray, coating droplets, or emissions of any kind, escape to

the atmosphere, the base of the tank, or adjacent buildings, private property, work sites and parking lots.

B. The containment system shall at a minimum meet the emission control requirements of a Class 2 System as specified in Section 4, 2.2.2 of SSPC-Guide 6 (CON), Guide for Containing Debris Generated During Paint Removal Operations, (Latest Edition). The ground surrounding the tank shall be protected from all debris, emissions, dust, and other materials generated in the cleaning operations with a minimum of two layers of polyethylene covered with plywood or the same material used for the perimeter containment system.

C. The CONTRACTOR shall be responsible for all materials that are used and for any apparatus used to contain dust emissions, debris, overspray, and coating droplets. The containment system attachments to the tank shall be designed by a Professional ENGINEER licensed in the State of Texas not to impose excessive loading on the tank. The CONTRACTOR shall submit the P.E. designed, stamped, and signed details of the containment system on the tank. The containment system will place additional loads on the tank that the tank was not originally designed for. The CONTRACTOR shall reinforce the tank as necessary to prevent permanent deformation and to assure that no damage occurs to the tank. Any damage to the tank as a direct or indirect result of the containment system shall be repaired or sections replaced by the CONTRACTOR at no additional cost to the OWNER. Neither the OWNER nor the Consultant assumes any responsibility for the structural ability of the tank to support the containment system.

D. Complete containment of the tank shall be utilized to contain all cleaning dust, debris, emissions, paint droplets, and paint overspray, the complete containment shall include a full bonnet.

E. If tarps are used as part of the containment system, the tarps shall be an impervious, solid, flame-resistant material, reinforced with a fiber mesh and shall allow as much light as possible to pass through the material.

F. The OWNER reserves the right to stop work or require additional or different containment methods if the CONTRACTOR's operations create a nuisance beyond the tank site property line in the sole opinion of the OWNER, the Consultant, the OWNER's designated representative, any regulatory agency, or neighbor. All costs of providing an adequate containment system shall be included by the CONTRACTOR in the Base Bid.

G. If robotic or creeper-type cleaning devices are used, the robotic or creeper-type device shall meet the same containment criteria as that of the types of containment (lack of emissions). All overspray and paint droplets shall be contained on the tank site.

H. Review of the containment system for containing the spent cleaning dust, debris, emissions, overspray, and coating droplets shall not warrant the structural integrity of the containment system and shall not warrant the structural integrity of the tank to support the containment system. Nor shall review of the containment system warrant the ability of the system to contain spent cleaning dust, debris, emissions, and overspray.

I. All attachments to the tank shall include a "reinforcing" pad/plate designed to distribute the loads and to prevent damage to the tank. The reinforcing pad/plate may remain in the tank at the completion of the project as long as the pad/plate is completely seal welded. All edges

ground to 1/8 in. minimum radius, and all submittals shall include, at a minimum, the following detail and descriptions.

1. Brackets/outriggers to be attached to tank including size, material, etc.
2. Bracket/outrigger attachments to the tank.
3. Number of brackets/outriggers and spacing on tank container.
4. Center roof "tree" and attachment details.
5. Reinforcing pad between structure and attachments.
6. Any additional roof support.
7. Size of cables to be used and locations.
8. Anchorage details of hoist and location
9. Ground Anchors.
10. Catalog cuts of tarp (screen) material.
11. Tarp/screen material connection and overlaps.
12. Design/operation parameters of containment, such as wind speed when containment shall be lowered or not used.
13. Ground Anchors
14. Other dust collection and Engineering controls
15. Any item desired to be left on the tank structure at the completion of the Project (subject to approval by the OWNER).
16. Maximum wind velocity which the containment system can remain raised and the procedure for which the containment system will be utilized on forecasted high/gusty wind days

1.06 DUST COLLECTION:

A. CONTRACTOR shall furnish, operate, and maintain adequate dust collection during the Project to achieve negative pressure within the containment or adequate air flow within the tank interior. The dust collection system shall at a minimum meet the requirements of a Type J1 Air Filtration system, as specified in Section 5.4.5.1 of the SSPC-Guide 6 (CON), Guide for containing Debris Generated During Paint Removal Operations. The dust collection shall be operated during all abrasive blast cleaning and until the area is clean enough for coating application. The CONTRACTOR shall be responsible for all sizing, design of ductwork, etc., based upon the CONTRACTOR's operations, number of blasters, duration of blasting, etc. The CONTRACTOR shall also take precautions to avoid a vacuum from developing inside the tank, as even slight vacuum inside of the tank may cause damage to the tank.

1.07 SUBMITTALS:

A. Environmental Controls: The CONTRACTOR shall submit to the ENGINEER a written plan describing environmental humidity and temperature climate controls for the tank interior. Submittal shall include equipment type, size, and power requirements. This submittal shall be for informational purposes only. Review of this submittal shall not constitute approval of the proposed method nor place any responsibility for the same upon the ENGINEER.

B. Shrouding: CONTRACTOR shall submit to the ENGINEER a written plan describing the type and performance of the proposed shrouding method. Performance data shall include time required to raise and lower shroud and containment efficiency. This submittal shall be for informational purposes only. Review of this submittal shall not constitute approval of the proposed method nor place any responsibility for the same upon the ENGINEER.

C. Blast Cleaning: CONTRACTOR shall submit to the ENGINEER a written plan describing the materials and methods proposed for use in blast cleaning. A separate submittal shall be made for each method proposed.

D. Paint: CONTRACTOR shall submit to the ENGINEER manufacturer's technical information including paint label analysis and application instructions for each material to be used. In addition, CONTRACTOR shall submit color samples for review of color and texture. CONTRACTOR shall submit Certificate of Approval from the manufacturer stating their ability to apply the interior lining system.

E. Paint Substitutions: As part of the proof of equality, the ENGINEER may require at the cost of the CONTRACTOR certified reports from a nationally known reputable and independent testing laboratory conducting comparative tests as directed by the ENGINEER between the product specified and the requested substitution. Two (2) comparative tests shall have been made within two (2) years prior to award of contract.

F. Welding Certification: Welding procedures and welding operators shall be qualified in accordance with AWWA D100.

G. TCEQ Notification: CONTRACTOR shall satisfy the requirements as set forth in 30 TAC, Rule 111 prior to blasting.

H. Overspray Plan: CONTRACTOR shall submit a written plan to the OWNER describing the measures to be taken to prevent oversprays, should they occur. The CONTRACTOR shall acknowledge in this submittal that any damage caused by oversprays to the Town’s property and neighboring property shall be the responsibility of the CONTRACTOR.

I. General: The CONTRACTOR shall submit to the ENGINEER, prior to substantial completion of the project, certification from the manufacturer indicating that the quantity of each coating purchased was sufficient to properly coat all surfaces. Such certification shall make reference to the square footage figures provided to the manufacturer and the ENGINEER by the CONTRACTOR.

1.08 QUALITY ASSURANCE

A. Qualification of Bidders: Each CONTRACTOR bidding this work shall be a specialist in the painting and rehabilitation of welded steel, multi-legged elevated storage tanks, welded steel ground storage tanks and water facilities.

1.09 DELIVERY, STORAGE AND HANDLING:

A. All materials shall be brought to the job site in the original sealed and labeled containers of the paint manufacturer, and shall be subject to inspection by the ENGINEER on the job.
B. The CONTRACTOR shall use one (1) convenient location for keeping all materials and doing all mixing, etc. Oily rags and waste shall be frequently removed, and under no circumstances shall they be allowed to accumulate.
C. All empty paint containers shall remain on the job site until such time as painting is complete and shall be subject to inspection by the ENGINEER on the job. Storage and disposal of empty paint containers must comply with TCEQ regulations.
D. Paint shall be stored in a secured area in compliance with paint manufacturer's recommendation.

1.10 JOB CONDITIONS:

A. No paint shall be applied when the surrounding air temperature, as measured in the shade, is below 40 degrees Fahrenheit. No paint shall be applied when it can be anticipated that the temperature will drop below 40 degrees Fahrenheit within 18 hours after the application of the paint. No paint shall be applied when the temperature of the surface is below 50 degrees Fahrenheit or within 5 degrees Fahrenheit of the dew point, whichever is greater. Paint shall not be applied to wet or damp surfaces, and shall not be applied in rain, snow, fog or mist, or when the relative humidity exceeds 85 percent. Dew or moisture condensation should be anticipated, and, if such conditions are prevalent, painting shall be delayed until surfaces are dry. Paint shall not be applied to surfaces which are hot enough to cause blistering or pinholing of the film. Refer to manufacturer's recommendations for the interior lining system and its recommended air temperature.
B. If the paint manufacturer's requirements are more stringent, the CONTRACTOR shall follow them instead.
C. During periods of inclement weather, painting may be continued by enclosing the surface with temporary shelters and applying artificial heat provided allowable environmental conditions as described above can be maintained.

1.11 WARRANTY

A. A paint manufacturer's representative shall be made available for an inspection annually for two (2) years from the date of final acceptance of the project by the OWNER at no cost to the OWNER. The maintenance and/or warranty period stipulated within the contract documents shall remain in force.
B. CONTRACTOR shall issue to the OWNER a two-year warranty for workmanship and materials from final acceptance. The CONTRACTOR's Performance Bond may be used to

assure this work, but will require Surety's acknowledgement prior to commencement of work on the project.

C. Coating Manufacturer shall issue to the OWNER a written fifteen-year material warranty for exterior coatings. Coating Manufacturer shall issue to the OWNER a written two-year material warranty for interior coatings.

1.12 MAINTENANCE MATERIAL

A. At the end of the project before final payment, the CONTRACTOR shall provide the OWNER coating manufacturer's or coating supplier's vouchers equivalent in value to five (5) one (1) gallon cans of each type and color of coating, primer, thinner, and other coatings used in the field including multiple component materials. Upon request by OWNER, the material shall be delivered in unopened, typed-labeled cans (including color, batch number and manufacturer date), just as it comes from the factory. If the coating manufacturer does not package the material in one (1) gallon cans, and in the case of special colors, the materials may be delivered in new larger containers, properly closed with typed, color, batch numbers and manufacturer date. The coating manufacturer's directions for use and literature describing the materials shall also be furnished to the OWNER in three (3) bound copies and a typed inventory list shall be furnished at the time of delivery. These vouchers shall remain valid for 10-years from date of issuance, date of issuance not to occur before Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. The following Coating Manufacturers are approved Coating Manufacturers. Any product that is not listed on the Approved Manufacturer List is considered a substitution and shall be submitted in accordance with Section 01 62 00.

1. Carboline Company
2. TNEMEC Company Incorporated

B. Indicate the CONTRACTOR'S proposed manufacturer on the bid form.

C. The approved products are approved for use on this project and reflect the desired standards of quality. Products of other nationally known and reputable manufacturers will be considered as proposed substitutions subject to the provisions of the General Conditions and paragraph 2.01 A above. All coating products shall be manufactured by the same manufacturer and coatings shall be from the same batch. Coating manufacturers may provide their latest formulation of the specified coatings in lieu of those listed. Manufacturer's substitutions must provide at least the same performance characteristics as the specified coatings under the specified application conditions. All substitutions must be approved by the ENGINEER.

2.02 EPOXY SEAM SEALANTS

A. Carboline Carboguard 501, Tnemec 215 Surfacing Epoxy, Sikaflex 227 NSF Approved, or approved equal.

2.03 PAINT AND THINNERS

A. Thickness of coatings shall be measured according to the procedures outlined in SSPC Paint Application 2 (PA 2) “Measurement of Dry Film Thickness (DFT) with Magnetic Gages”, November 2018 or current edition. Measurements shall conform to Level 2 requirements.

2.04 SURFACE PREPARATION

A. Contractor shall perform surface preparation as stated in PART 3 – EXECUTION.

2.05 STEEL INTERIOR COATINGS

A. Colors: The color of the 2nd coat and stripe coat shall contrast with the 1st and 3rd coats. Finish coat color to be **tank white** as selected by OWNER from submittal.
B. C1 Interior Base Bid: Carboline

1. Prime coat: Carboguard 61 Epoxy applied at 4 to 6 mils DFT.
2. Stripe coat: Carboguard 61 Epoxy applied at 2 to 3 mils DFT applied by brush.
3. Intermediate coat: Carboguard 61 Epoxy applied at 4 to 6 mils DFT.
4. Finish coat: Carboguard 61 Epoxy applied at 4 to 6 mils DFT. Full Color Coverage

C. C1 Interior Base Bid: Sherwin-Williams

1. Prime coat: Corothane 1 Galvapac 1K or 2K Zinc applied at 2.5 to 3.5 mils DFT.
2. Stripe coat: Sherplate 600 Epoxy applied at 3 to 6 mils DFT applied by brush.
3. Intermediate coat: Sherplate 600 Epoxy applied at 4 to 6 mils DFT.
4. Finish coat: Series Sherplate 600 Epoxy applied at 4 to 6 mils DFT. Full Color Coverage

D. C3 Interior Alternate Bid: Carboline

1. Prime coat: Series 94-H2O Hydro Zinc applied at 2.5 to 3.5 mils DFT.
2. Finish coat: Series 22 Epoxoline or FC22 Epoxoline applied at 20 to 40 mils DFT. Full Color Coverage

E. C3 Interior Alternate Bid: Sherwin-Williams

1. Prime coat: Corothane 1 Galvapac 1K or 2K Zinc applied at 2.5 to 3.5 mils DFT.
2. Finish coat: Dura-Plate UHS Epoxy applied at 18 to 20 mils DFT. Full Color Coverage

F. Interior Coatings must be ANSI/NSF Std. 61 approved for potable water storage.
G. Stripe coats: shall be applied by brush to all weld seams, edges, corners, bolts, nuts and other difficult to coat areas.

2.06 STEEL EXTERIOR COATINGS

A. Surface Preparation: See Technical Specification 02830 Removal of Lead Based Coatings.
B. Colors: Provide color submittal for selection by the Owner. The color of the 2nd coat shall contrast with the 1st and 3rd coat. Finish coat color to be **aluminum gray** as selected by OWNER from submittal.
C. C2 Exterior Bid: Carboline

1. Prime Coat: Carbozinc 859 applied at 2 to 4 mils DFT.
2. Stripe Coat: Carboguard 60 applied at 2 to 3 mils DFT applied by brush.

3. Intermediate Coat: Carboguard 60 applied at 4 to 6 mils DFT.
4. Finish Coat: Carbothane 134 HS applied at 2 to 3 mils DFT.

D. C2 Exterior Base Bid: Sherwin-Williams

1. Prime Coat: Corothane 1 Galvapac 1K or 2K Zinc applied at 2.5 to 3.5 mils DFT.
2. Stripe Coat: Macropoxy 646 FC Epoxy applied at 2 to 3 mils DFT applied by brush.
3. Intermediate Coat: Macropoxy 646 FC Epoxy applied at 4 to 6 mils DFT.
4. Finish Coat: Acrolon Ultra Polyurethane applied at 3 to 5 mils DFT.

E. C4 Exterior Alternate Bid: Carboline

1. Prime Coat: Carbozinc 859 applied at 3 to 5 mils DFT.
2. Stripe Coat: Carboguard 890 applied at 2 to 3 mils DFT applied by brush.
3. Intermediate Coat: Carboguard 890 applied at 4 to 6 mils DFT.
4. Finish Coat: Carboxane 2000 (Siloxane) applied at 3 to 5 mils DFT.

F. C4 Exterior Alternate Bid: Sherwin-Williams

1. Prime Coat: Corothane 1 Galvapac 1K or 2K Zinc applied at 2.5 to 3.5 mils DFT.
2. Stripe Coat: Macropoxy 646 FC Epoxy applied at 2 to 3 mils DFT applied by brush.
3. Intermediate Coat: Macropoxy 646 FC Epoxy applied at 2 to 3 mils DFT.
4. Finish Coat: Sher-loxane 800 Polyiloxane applied at 4 to 6 mils DFT.

2.07 EQUIPMENT:

A. Agitator: The CONTRACTOR shall provide a suitable mechanical agitator and shall agitate all paint until proper dispersion of materials is secured. All paint ingredients shall be in a satisfactory dispersed condition at the time of application. Use equipment that conforms to the paint manufacturer's requirements.

2.08 MATERIALS:

A. Blast Cleaning Abrasives: Blasting shall be done with an abrasive material of non-silica composition. This abrasive material shall be clean, dry, and free of clay particles and other extraneous matter. The abrasive material must be approved by the OWNER's representative before blasting begins. Coal slag and copper slag are not allowed.
B. Compressed Air used for blasting shall be free of detrimental amounts of water and oil. Adequate traps and separators shall be provided at the compressor.
C. Rust Inhibitor compatible with the coating systems shall be included in water for wet blasting.

PART 3 - EXECUTION

3.01 GENERAL

A. The CONTRACTOR and all workmen employed by him shall conduct all operations in a clean and sanitary manner and in conformance with all aspects of the General Conditions. CONTRACTOR shall at all times provide dust and overspray controls for blasting and painting operations. Coating application procedures shall conform to the standards of

craftsmanship as discussed in the Steel Structures Painting Manual, Volume 1 "Good Painting Practice."

3.02 SURFACE PREPARATION

A. All surfaces shall be prepared in accordance with the paint manufacturer's recommendations and as a minimum shall be cleaned free of all old paint, rust, corrosion, mill scale, oil and grease. During the cleaning or other operations inside the structure, all interior controls, floats, cathodic wiring, etc., to remain must be protected from damage, and a cover shall be provided over the entrance of all pipes to prevent foreign matter from entering the pipes.
B. Prior to abrasive blasting, all surfaces, both inside and outside, shall be thoroughly waterjet cleaned with clean potable water per SSPC-WJ-4/NACE WJ-4, Paragraph 6.1.1.1 with a minimum pressure of 3,000 psi to remove all dust, dirt, oil, grease, chalk, and other contaminants. Remove heavy deposits of grease or oil from surface prior to any other surface preparation. Neutralize and properly dispose of contaminants prior to any other surface preparation.
C. SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular **anchor** profile of minimum 1.5 mils.

3.03 SPOT CLEANING

A. All rust, peeled or cracked paint, overspray, runs, sags and non-adherent paint shall be removed. All exposed edges of the remaining paint shall be feathered, and spot cleaning shall be conducted in a manner to minimize damage to sound material. All foreign matter shall be removed from seams, pickets, joints and the bottom of the columns and plates.
B. In the case of new construction, the CONTRACTOR has the following option: The surface preparation may be done by acid treatment, and primer immediately following, or the surface preparation may be done by blast cleaning and primer immediately following. The cleaning and priming shall be done in the shop. All paint, primers and paint thinners, including primer for shop-primed components, shall be from the same approved manufacturer.
C. All surfaces to be painted shall receive a final brush blast immediately before applying the initial coating. The time limit between final blasting and initial coating shall be in accordance with the manufacturer's recommendations, and in no case shall this time period exceed two (2) hours.

3.04 REPAIRS

A. Pit and Seam Welding: Pit and seam welding shall include all pits and seams with a depth equal to or greater than 1/8 of an inch. All other corrosion shall be repaired and seams re-welded as necessary to prevent future leaks and to protect the integrity of the coating system.
B. Surface Grinding: The CONTRACTOR shall grind and round all sharp edges.
C. Weld Grinding: All welds shall be continuous, ground to a curve and free of porosity, pockets, high spots, rough projections and ripples to provide a coatable surface as defined by NACE SP0178, Designation D. All welds shall be blended smoothly into plate surface. All weld slag, splatter and flux shall be removed prior to blasting.

3.05 APPLICATION:

A. Ventilation: The CONTRACTOR must provide adequate reverse chimney effect forced air ventilation while painting or coating the interior surfaces of a tank. The ventilation shall be adequate to remove fumes, prevent the possibility of an accumulation of volatile gases, protect workmen and prevent damage to the tank. The CONTRACTOR shall be held financially responsible for all damage to the tank caused by inadequate ventilation.

B. Mixing: Splitting paint kits and mixing of partial kits is not allowed. Mix only whole kits and discard any leftover paint. Mixing of all coatings must be performed in strict compliance with the manufacturer's recommendations.

C. General Application: All paint and finishing materials shall be applied by skilled workmen and shall be brushed or sprayed in even, thorough coats without runs, crazing, sags or other blemishes. All coats, regardless of material, shall be thoroughly dry before applying succeeding coats. Full drying time as recommended by the manufacturer of the particular paint involved shall be allowed between coats. All products shall be applied in strict accordance with the manufacturer's recommendations. Painting systems shall be applied by one or more of the following described methods. However, spray application will not be permitted for exterior surfaces unless the CONTRACTOR contains overspray by a method acceptable to the ENGINEER. Application equipment shall meet manufacturer's recommendations.

D. Brush Application: Only top quality hog hair or synthetic bristle brushes shall be used. All paint shall be applied so as to form a uniform film of a thickness which is consistent with the specified coverage for the paint being used. Sufficient cross brushing shall be used to insure filling of all surface irregularities and complete coverage. Particular care shall be used in painting corners and other restricted places to obtain uniform application. All final brushing strokes shall be made in the same direction and toward the previously applied paint.

E. Roller Application: Rollers used for applying coatings shall be of the highest quality and must be kept as clean as possible at all times. Any coating rolled on must form a uniform film and must give the same end results as a brushed on coat. Rolling shall be supplemented by brushing in areas where rolling could not give complete coverage, such as corners, edges, welds, crevices, bolts, rivets or other irregular surfaces. The use of rollers on the tank interior surfaces is not allowed.

F. Spray Application: When paint is applied by spraying, the air gun used shall be adjustable for regulation of the air and paint mixture. The equipment shall have a suitable water trap to remove moisture present in the compressed air. Paint pots shall be equipped with an agitator to keep the paint well mixed. All equipment shall be thoroughly cleaned at the end of each day's work. The width of the spray shall be not less than twelve (12) inches or more than eighteen (18) inches. The pressure shall be suitable for type of paint used. Frequent checks shall be made to insure maintenance of correct spreading rate; care shall be taken to see that edges, corners, and bolt heads are completely covered, and that there has been no bridging over the film. Airless spray application is acceptable with prior approval of the ENGINEER. If CONTRACTOR uses a plural component spray equipment, the spray equipment shall be of the same type and setup used for certification of the CONTRACTOR to apply the product.

G. Cleanup: At the completion of the work, the CONTRACTOR shall clean off all paint spots, oil and stains from surfaces and leave the entire project in a satisfactory condition. Special

attention shall be given to the tank foundation in that it shall be protected at all times from paint splatter. Any overlapping of the paint onto the concrete shall be cleaned by grinding or other methods as approved by the ENGINEER. The CONTRACTOR shall contain all waste and process discharge in accordance with the accepted methods for the process and materials that are in abatement. All waste shall be contained and characteristics determined in accordance with EPA regulations found under 40CFR216 Subpart B-Criteria for identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste and applicable TCEQ regulations. If the waste is not a hazardous waste under the regulations that govern and is eligible for disposal in a city landfill, it shall be the CONTRACTOR's responsibility to properly load, secure, transport, and dispose of all such waste. If the waste is found to have one (1) of the eight (8) characteristics of hazardous waste or to be a listed hazardous waste, the CONTRACTOR shall secure the materials and containerize them providing labels and markings in accordance with the EPA, TCEQ, and DOT regulations. The CONTRACTOR will take responsibility for and dispose of the waste if it is determined to be a regulated hazardous waste. Cost associated with disposal of hazardous waste shall be included in the CONTRACTOR's bid and shall be considered subsidiary to the various pay items shown in the Bid Proposal.

3.06 STRIPE COAT – INTERIOR AND EXTERIOR SURFACES

A. See PART 2 – PRODUCTS for stripe coat material. All coatings shall be NSF certified (for ground storage tank interior applications), applied by brush and thinned according to written coating manufacturer's recommendations applied to all welds, weld seams, and tack welds (new and old), edges, bolts rivets, ladder rails and rungs, seamed corners, joints of any kind and locations where brackets, lugs and other difficult to coat surfaces. Stripe coat and all welds and weld seams shall extend two (2) inches minimum, below and beyond all welded sections.
B. Stripe coat shall occur in coating system layering as stated in PART 2 – PRODUCTS.
C. Stripe coat is accomplished by moving the brush back and forth in a scrubbing motion working primer into all crevices. Stripe-coat shall be performed with a high quality bristle brush using primer that has been thinned according to manufacturer's instructions. Bristles left on the surface shall be removed before the coating dries. If bristles are discovered after the coating has dried, the bristle shall be removed, the coating removed, and the area correctly re-coated at no additional cost to the OWNER.
D. Stripe coating shall be tinted such that it can be easily distinguished from the other coats

3.07 DEHUMIDIFICATION

A. Dehumidification equipment shall be used to control the environment in the reservoir wet area and roof 24 hours a day during blast cleaning, coating application and coating cure. Approved automatic real time monitoring equipment shall be provided. This equipment shall be used when no Contractor personnel are on site.
B. Dehumidification equipment may be used to control the environment in the pedestal, dry riser and dry well 24 hours a day during blast cleaning, coating application and coating cure. If the Contractor uses dehumidification to control the environment in the pedestal, dry riser and dry well, the Contractor shall furnish dehumidification at his expense.

C. Desiccant dehumidifiers are required and will be a solid desiccant design having a single rotary desiccant wheel capable of fully automatic continuous operation. No liquid, granular, or loose lithium chloride drying systems will be accepted. The desiccant wheel shall be made of a fire retardant material tested to ASTM standard E 84-90. Air conditioning units may be used only if in combination with Desiccant units to control temperature.

D. The Contractor shall furnish all labor, materials, equipment, fabrication and quality control inspections, and all other incidentals required to control and maintain the environment of the reservoir within the parameters stated in this specification and shall incorporate these and any other expenses into his bid.

E. The Owner reserves the rights, in the event the dehumidification equipment is not performing to the minimum requirements stated in this specification, to require the Contractor to modify and or add additional equipment to satisfy the conditions of this specification, at the sole cost to the Contractor. It is the Contractor's responsibility to provide adequate dehumidification equipment to meet this specification and Coating Manufacturer's requirements.

F. Coating Manufacturer's minimum limits of surface temperature, interior reservoir air temperature and relative humidity requirements shall govern if more stringent than the requirements stated within this Specification:

1. Surface Temperature:
2. Abrasive cleaning operations:
3. Dew point- minimum of 5 degrees below the surface temperature of the reservoir interior.

G. Coating operations:

1. Surface temperatures shall be maintained at a minimum of 40° F or the published Coating Manufacturer's recommendations. Coating Manufacturer's recommendations shall govern if minimum temperature required is greater than 40° F. The maximum air and surface temperature shall not exceed the published recommendation of the Coating Manufacturer.
2. Dew point- minimum of 17 degrees below the surface temperature of the reservoir interior.

H. Relative Humidity:

1. Abrasive cleaning operations:
   a) The relative humidity of the reservoir inside ambient air shall not exceed 55% RH as measured by a sling psychrometric or another measuring device such as a continuous EMD (electronic monitoring device).
   b) The reservoir inside ambient air shall be maintained, as stated in the preceding paragraph, until the abrasive cleaning operations have been completed and coating operations have covered all bare substrates.
2. Coating operations:
   a) During coating operations the relative humidity of the reservoir inside ambient air shall not exceed 55% RH as measured by a sling psychrometric or another measuring device such as a continuous EMD (electronic monitoring device).

3. Coating curing:
   a) During coating curing the relative humidity of the reservoir inside ambient air shall not exceed 75% RH as measured by a sling psychrometric or another measuring device such as a continuous EMD (electronic monitoring device).

I. Air Change:

1. Abrasive cleaning and coating operations: The equipment shall be sized so that it is capable of changing the volume of the air inside the entire reservoir a minimum of one (1) time per hour during abrasive blasting and coating operations.

J. Coating curing:

1. Dew point- minimum of 10 degrees below the surface temperature of the reservoir interior.
2. During coating curing and when no coatings are being applied inside the reservoir the equipment shall be sized so that it is capable of changing the volume of the air inside the entire reservoir a minimum of two (2) times per hour.
3. Forced air ventilation shall continue for a minimum of seven (7) days or longer after the final coat has been applied or as required by temperatures as recommended by the coating manufacturer.

K. Air Distribution:

1. The process air shall be distributed so as to be able to contact the entire reservoir interior. If necessary, special equipment shall be provided to achieve this requirement.
2. To prevent the introduction and distribution of moisture into the controlled environment during the abrasive cleaning operation, air compressors shall be operated with after coolers or deliquescent dryers for moisture removal.
3. Air filtration/dust collectors shall be used in conjunction with the dehumidification equipment during blasting operations.

L. Power: All desiccant dehumidification units shall be propane powered. However, if sufficient electrical power is available, electrical power may be used. Use of air conditioning to achieve dehumidification is not acceptable.

3.08 DISINFECTION:

A. Comply with requirements in section 33 04 40.

3.09 FIELD QUALITY CONTROL:

A. General: All work and materials supplied under this specification shall be subject to inspection by the OWNER or its representative. The OWNER reserves the right to hire a full-time independent third party NACE inspector. All parts of the work shall be accessible to the inspector. The CONTRACTOR shall correct such work or replace such material if found defective. Such inspection will not relieve the CONTRACTOR of the responsibility of furnishing qualified labor and materials in strict accordance with the specifications.

B. Threshold Inspections: At certain stages in the project the CONTRACTOR will not be allowed to proceed until a thorough inspection has been performed by the OWNER's

representative and the OWNER's representative has approved the work up to that point. The following threshold inspections will be required:

1. Surface Preparation and Repair Completion: After all repairs have been made and surfaces prepared in accordance with these specifications and the coating manufacturer's instructions. The project site or area to be painted (interior or exterior of tank) shall be cleaned and ready for coating operations to begin.
2. Completion of Each Coat: After each prime coat application and touch up; when the tank is ready to receive the following coat.
3. Substantial Completion: When all work and clean up is completed and prior to CONTRACTOR moving equipment and manpower off the job.

C. The CONTRACTOR will notify the OWNER forty-eight (48) hours in advance of needing threshold inspection. Prior to scheduling the inspection, the CONTRACTOR shall have sufficiently reviewed his work and believe it to be ready for threshold inspection. The cost of additional threshold inspections required because work was not approved at the original threshold inspection will be borne by the CONTRACTOR. The threshold inspections will not relieve the CONTRACTOR of his responsibility to furnish qualified labor and materials in accordance with the specifications.

D. Quality Control Log: The CONTRACTOR shall maintain a quality control program to include a daily log, and at a minimum, the following quality control checks:

1. Daily compressed air blotter test.
2. Surface preparation visual checks using SSPC VIS 1-89.
3. Surface profile checks periodically using Testex Replica Tape.
4. Wet film thickness, periodically as coating is applied using an approved gauge.
5. Dry film thickness, daily and periodically as coating dries, using an Elcometer Thickness gauge or equal.
6. Holidays, daily and periodically as needed using an approved low voltage holiday detector.
7. Environmental condition, minimum of twice daily, once prior to beginning work and once in the afternoon to include:
   a) Ambient temperature.
   b) Dew point and relative humidity using a sling Psychrometer and U.S. Weather Bureau Psychometric Charts.
   c) Steel surface temperatures on at least two opposite sides of tank using surface sensing thermometers.
   d) Wind speed and direction.

E. The CONTRACTOR's daily log shall be kept on site at all times and be made available for review by the OWNER or OWNER's representative on demand. The daily log shall include as a minimum the following information:

1. Date.
2. Name of CONTRACTOR.
3. Project Name.

4. Name of Person making Log Entry.
5. Specific Progress
   a) Areas of tank blasted
   b) Repairs made including location
   c) Coatings applied and location
   d) Touch Up work and location
6. Environmental conditions as listed in Paragraph 3.08.C.7., and the time readings were taken.
7. Locations and results of all quality control checks.
8. Product manufacturer and batch numbers of coatings used that day.
9. Problems encountered and action taken as a result.

F. Testing Equipment: The CONTRACTOR shall furnish an approved type dry mil gauge apparatus to measure the dry film thickness. The Elcometer Thickness Gauge or equal shall be furnished to the OWNER for his use. The CONTRACTOR shall also furnish to the OWNER, for his use, holiday detector devices. Holiday detector devices shall be approved low-voltage type. All of the above inspection gauges shall be furnished and on the job before the OWNER will permit painting operations to proceed and shall remain on the job until its completion and acceptance. The CONTRACTOR or his representative shall instruct the OWNER on the proper use, care and calibration of all such gauges. The above-required testing gauges and calibration materials shall be furnished to OWNER and are returnable to the CONTRACTOR upon completion of the job. The cost of furnishing all of the above required gauges to the OWNER for his use shall be borne by the CONTRACTOR.

G. Bacteriological Testing: Following disinfection, the tank shall be filled and sampled by the CONTRACTOR for bacteriological testing, prior to being put into service. The testing shall be as described in AWWA Specification C652-92, Section 4.4 - Bacteriological Sampling and Testing. Results of the test shall be reviewed by the ENGINEER. Final decision upon the suitability of the disinfection procedure shall rest with the ENGINEER. Should repeat of the disinfection procedure be required, additional cost of disinfection, testing and water to fill the tank shall be borne by the CONTRACTOR at no additional cost to the OWNER.

3.10 TESTING/OBSERVATION

A. Observations shall be conducted by the Owner's Representative or a third party inspection company and the Owner's Representative. Final observations shall be performed in the presence of the Owner or their Representative and the Contractor's Superintendent. All materials and equipment used in the accomplishment of testing are subject to observation at any time by the Owner and/or Inspector. Periodic observation times will be agreed upon by the Inspector and Contractor, and approved by the Owner.

B. The Owner may conduct the tests and observations to verify the Coating Manufacturer's data. If the coating testing results fall below the test requirements or visual observation, the Owner reserves the right to have the Contractor change coating materials and/or Coating Manufacturers to a coating that will meet ALL the stated requirements in this Specification.

C. All steps of the coating system will be subject to observation prior to progression to succeeding steps. Phases of observation shall include, but not limited to:

1. Pre-cleaning (before surface preparation) survey of facilities to be primed
2. During surface preparation and prior to coating application
3. During and immediately after each coating application
4. Final coating observation
5. Pre-disinfection

D. The Contractor shall not move or remove scaffolding, ladders or other fixtures necessary to provide proper observation until such work has been observed and approved by the Inspector and/or the Owner's Representative.

E. Any work found to be deficient, damaged, or otherwise unacceptable shall be repaired in accordance with the Coating Manufacturer's latest written repair recommendations at no additional cost to the Owner.

F. Owner and Owner's Representative will make every attempt to minimize damage to newly coated areas during observation activities, but any damage caused, regardless of by whom, shall be repaired by the Contractor at no additional cost to the Owner.

G. Observation and/or acceptance of Contractor's work by Owner, Inspector or their Representatives in no way releases Contractor from any of the terms and conditions of the Contract Agreement.

H. The following test and observations will be performed:

1. Surfaces of all steel shall first be cleaned and observed by the Contractor's Superintendent to ensure that all grease, oil, and other foreign materials have been removed before coating. Any area found to be improperly cleaned, shall be redone to the OWNER'S Representative's satisfaction. Final surface preparation shall be as outlined in the Steel Structures Painting Council's Surface Preparation Specifications SSPC SP1 through SP11. Prior to observation of all interior and exterior surfaces by Owner's Representative, Contractor's Superintendent shall observe and confirm readiness for inspection.
2. The pattern depth of the abrasive blasted surface shall be as specified by the Coating Manufacturer's written surface profile recommendations, see coating schedule for minimums. The profile shall be measured by a Testex Tape. SSPCVis- 1 Pictorial Surface Preparation Standards shall serve as guides and in arbitration to determine the degree of surface preparation. Each and every square foot of the reservoir surface interior and exterior shall be prepared as per SSPC visual standards.
3. Before and/or during blasting and coating operations, a field observation and possibly a field test of ventilation flow-rates may be performed by the Owner to verify that the ventilation requirements are being provided.
4. All waste testing shall be performed by the Contractor using a third party inspection company approved by the Owner. Reports shall be submitted to the Owner and approved prior to removal of waste from the site. If the waste is not a hazardous waste under the regulations that govern and is eligible for disposal in a city landfill, it shall be the Contractor's responsibility to properly load, secure, transport, and dispose of all such waste. The Contractor shall submit a copy of all waste transportation invoices to the Owner within seven (7) calendar days of waste removal.

5. If the waste is found to have one (1) of the eight (8) characteristics of hazardous waste or to be a listed hazardous waste, the Contractor shall secure the materials and containerize them providing labels and markings in accordance with the EPA, TCEQ, and DOT regulations. The Owner will take responsibility for and dispose of the waste if it is determined to be a regulated hazardous waste.
6. Measurement of the dry film thickness shall be made in accordance with SSPCPA2 (November 2018 or latest edition) with magnetic or digital gauges. Measurements of the actual dry film thickness of the various coating layers applied shall be made by the Owner's Representative with assistance from Contractor. Final film thickness measurements shall be made at such locations as designated by the Owner and/or Owner's Representative.
7. Holiday Testing: One holiday test shall be performed on the interior coating system; after the Intermediate Coat has cured for at least 2 days, all interior surfaces shall be tested for pinholes using a wet sponge low voltage holiday detector in accordance with AWWA D102-03 in the presence of the Field Inspector and an Engineer. All touched up pinholes and re-coated areas shall cure for a minimum of seven (7) days prior to re-testing for holidays. During the wet sponge testing, defective areas shall be marked for repair and retested after repair work has been completed. Following the application of the Finish Coat the interior wet coatings shall be holiday tested using same procedures as before. Holiday testing and re-testing shall continue until the interior surfaces are found to be holiday free. A Tinker-Rasor (or equal) Low Voltage Holiday Detector shall be used for all holiday testing. The coating system must pass the holiday test regardless of the mil thickness existing.
8. No pinholes, holidays, or other irregularities will be permitted in the final interior coating inspection.
9. On days when blasting and/or coating is being performed, the Contractor shall monitor and record ambient climatic conditions, and interior reservoir conditions as follows:
10. Air temperature, steel surface temperature, humidity and dew point shall be measured and recorded by the Contractor prior to beginning of blasting and prior to application of coating, daily. Surface temperature shall be measured using Owner approved thermometers. Temperature of both the sunny side and shady side of the reservoir shall be recorded periodically each day. The reservoir surface temperatures, relative humidity, dry bulb, wet bulb and dew point temperatures, both interior and exterior (as appropriate), are to be recorded at least every (3) three hours. The dew point shall be measured by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. The Contractor shall use a form approved by the Owner for recording this data. The completed forms shall be kept on the job site at all times from the time coating is first applied until the coating system is complete.
11. All coatings submitted shall pass a 7-day chemical spot test to the following chemicals with no cracking, blistering or delamination.
    a) 1, 1, 1 Trichloroethane
    b) Methyl Ethyl Keytone (MK)
    c) Ethanol

3.11 ANNIVERSARY INSPECTION

A. The CONTRACTOR shall observe all surfaces of the reservoir with the OWNER within 11 to 23 months after the reservoir work has been accepted for Substantial Completion and placed in service. If an observation date has not been established within 23 months after the reservoir has been placed in service, the anniversary observation shall be considered waived, except in the event the OWNER is unable to remove the reservoir from service due to extremely long dry climate conditions or otherwise adverse weather conditions or due to unexpected breakdowns in the distribution system. The date of anniversary observation may be extended for a period of time not to exceed thirty (30) months beyond the date of Final Completion and acceptance of the work.

B. If failures in any portion of the reservoir surface exceed five (5) percent of that portion, as determined by the OWNER, then for that portion, the entire coating system shall be completely removed, re-coated and re-tested in accordance with the specifications herein. In the event any portion of the reservoir surface requires repair, partial or complete, a second anniversary observation shall be made unless the OWNER otherwise deems it not to be necessary. If subsequent anniversary observations are made, time stipulations, coating removal, repair; re-testing requirements shall be the same as provided for in this Specification. Each subsequent repair will have a warranty observation to occur within 11 to 23 months after the repair is completed.

C. The OWNER will isolate the reservoir from the distribution system and drain the reservoir. The CONTRACTOR shall open, clean out, high-pressure water wash and rinse the tank prior to the anniversary observation. After observation of the tank is complete and repair work accepted by OWNER, the CONTRACTOR shall follow disinfection procedures specified in section 3.06. Disinfection of the tank, after anniversary observation, shall be by OWNER as described above should CONTRACTOR meet cleanliness requirements.

D. The CONTRACTOR shall provide suitable and adequate equipment including, lighting, ventilation, rigging, cable climbers, mirrors, inspection equipment, and sufficient man-power to clean, disinfect and move equipment and tools around the tank, etc., as may be necessary to facilitate complete observation of all interior surfaces. The CONTRACTOR shall bear all costs of the anniversary observation and shall incorporate such costs into his bid. Two (2) percent of the bid amount will be retained and paid upon satisfactory observation and/or approved repairs.

E. Any location, including but not limited to locations where a coating has peeled off, bubbled, blistered, chipped, or cracked, etc., or where pinholes and/or Holidays are present and locations where rusting or corrosion is evident, will be considered a failure or defect of the coating system and shall be repaired as required. Repairs will be made at areas or locations where coating failures are found, even though metal surfaces may be protected by a cathodic protection system.

F. Methods of testing for coating failure which, may or may not be evident, shall include, but not be limited to, adhesion tests, film thickness measurement, Holiday testing, etc. Testing may be non-destructive or destructive. The CONTRACTOR, at his expense, shall repair all areas where destructive tests are performed.

G. The anniversary repair work shall be completed within an agreed time period as determined by the OWNER and CONTRACTOR. All repairs shall be made as per the Coating Manufacturer's written repair work instructions or that which is approved and acceptable to the OWNER and completed within ninety (90) calendar days of the anniversary observation. Holiday testing will be used to check all reservoir interior coating repairs, including the interior roof.

END OF SECTION

SECTION 11250

TANK MIXING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the requirements to furnish and install reservoir circulation equipment (also known as a mixing system) within the existing tank bowl.

1.02 REFERENCE STANDARDS

A. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
B. NSF International (NSF):

    1. 61, Drinking Water System Components - Health Effects.

C. Underwriters Laboratories Inc., UL 508

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01300.
B. All submittals shall be approved by the Engineer or the OWNER prior to delivery.
C. Submit the following:

    1. NSF-61 Certification for all equipment placed in contact with potable water including the motor and cable.
    2. Sufficient information to show that the equipment meets this specification.
    3. Electrical wiring diagrams as required for the installation.
    4. Manufacturer’s catalog cut sheets are not acceptable.
    5. Operation and Maintenance Manuals.
    6. General equipment specifications and data sheets
    7. Installation, start-up, operation, and maintenance instructions
    8. Factory-recommended maintenance schedule
    9. Wiring diagrams specifying what electrical wiring needs to be done onsite during and prior to the installation, and by which responsible party
    10. List of equipment or tooling necessary for diagnostics, trouble-shooting, repair or general maintenance

1.04 PROJECT CONDITIONS:

A. Working Conditions

    1. Safety and Health - The Contractor shall comply with safe working practices and all health and safety regulations of OSHA, state and local health regulatory agencies and Material Safety Data Sheets (MSDS). Provide protective and lifesaving equipment for persons working at the site.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect all parts so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
B. Protect all equipment and parts against any damage during a prolonged period at the site.
C. Protect the finished surfaces of all exposed flanges by wooden blank flanges, strongly built and securely bolted thereto.
D. Protect finished iron or steel surfaces not painted to prevent rust and corrosion.
E. Prevent plastic and similar brittle items from being directly exposed to sunlight or extremes in temperature.
F. Secure and maintain a location to store the material in accordance with Section 01600.

1.06 QUALITY ASSURANCE

A. Each mixing system shall be tested prior to deployment according to the manufacturer's standard factory testing practices at the factory testing facilities.
B. Complete mixing system is NSF/ANSI Standard 61 certified by NSF

1.07 WARRANTY

A. For the period of time beginning with installation or 3 months after shipment to Owner, whichever is earlier and ending on the time periods listed below, warrant equipment to be free from defects in material and workmanship and to conform specifications for:

1. Three (3) years on all supplied parts
2. One hundred twenty (120) days labor

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The following mixing equipment manufacturers have been preapproved:

Manufacturer	Model	Contact Information
Pax (UGSI)	PWM150	860 Harbour Way South, Richmond, CA 94804 866.729.6493

B. Any product that is not listed above is considered a substitution and shall be submitted in accordance with Section 01 25 00. Substitutions must comply with the requirements of this specification.

2.02 POWER

A. This power system requires a 120 VAC power source, 15 Amp rated outlet located at the controller of the circulation equipment. Contractor will install and supply 120 VAC power source and coordinate with local power company for connection.

2.03 SYSTEM OPERATION MONITORING.

A. The controller shall have the option to add an indicator LED for motor rotation.

2.04 SCADA INTEGRATION

A. The digital controller shall output system states of health and operation monitoring using RS-232 serial communications (Modbus RTU), DB9 male connection point. Provide a protocol document for local network (PLC or RTU) programming assistance.

2.05 PREVENT MOVEMENT AND ROTATION

A. Prevention of movement and rotation of circulation equipment: The circulation equipment shall be prevented from movement and rotating by the weighted intake assembly that is connected to the water intake hose and rests on the tank or reservoir floor.

2.06 ELECTRICAL POWER

A. Contractor will provide conduit, power cable and connections in accordance with manufacturer recommendation to connect Mixing System to Power Panel provided in design documents.

2.07 CONSTRUCTION

A. Equipment entering tank shall not adhere to, scratch or otherwise cause damage to internal tank coating or put undue stress on the materials of the tank construction. Equipment shall fit through a standard hatch of size 12” x12” or larger.
B. Contractor will penetrate tank roof within 2-feet of the roof hatch and install a water tight seal to allow motor cable entry into the tank.

2.08 NOZZLE

A. AISI Type 316 Stainless Steel

2.09 NOZZLE HOUSING

A. AISI Type 316 Stainless Steel
B. Brush finish to minimize surface corrosion
C. Buoyancy mechanism to keep nozzle pointing upright no matter the angle of the tank floor
D. Chlorine/chloramine resistant rubber foot pad to avoid scratching tank floor
E. Integrated power cable and lowering mechanism for simplicity

2.10 MOTOR

A. Stainless Steel 304 body
B. Chlorine/Chloramine resistant rubber seals
C. Fully submersible

2.11 CONTROL MECHANISM

A. Signal Phase 115VAC or 230VAC configurations: Component – On/Off Safety Disconnect Switch with indicator light and SCADA Interface.

2.12 ENCLOSURE

A. Type 3R
B. Lockable
C. Weather Resistant

D. Indicator light showing Mixer run status
E. Manual On/Off Switch
F. SCADA Interface: Digital output indicating motor running (Output contacts are SPDT, UL/CUR File E44211 Approved Contact Ratings)

2.13 CONTROLS

A. Each unit shall be equipped with all necessary controls, inter-wired, to provide the following minimum functions:

1. On/Off switch to control power to mixer.
2. Automatically activated motor shut-off if water level drops below motor height in tank.
3. Sine filter
4. Any other controls shown on electrical and instrumentation drawings

PART 3 - EXECUTION

3.01 INSTALLATION:

A. The circulation equipment manufacturer shall provide Installation, Startup, and On-Site Water Testing Services to insure (a) proper machine spatial placement in the reservoir, and (b) proper intake depth setting.
B. The Contractor shall be responsible for installation, connection of piping, electrical and instrumentation, and coordination of startup and testing in concert with the system.
C. The field services shall be performed by full time factory employees experienced in the operation of this equipment, and who have completed safety trainings required for this type of installation in compliance with OSHA regulations including (a) Working over Water, (b) Boating Safety, (c) Disinfecting Procedures, (d) Confined Space Entry, (e) Fall Protection, and (f) DOT Compliance.
D. Within 30 days following installation, the manufacturer shall provide an installation report detailing as described in submittal section.
E. The circulation equipment manufacturer shall have the following support team available for full service if ever needed following the installation. Provide a minimum of 4-member factory crew.
F. A full customer service staff including engineers and science personnel that are trained for assistance in this application.
G. The circulation equipment manufacturer shall provide minimum of 2-hour, on-site training to Owner personnel on the use of circulation equipment. Training materials will be submitted as a shop drawing for approval at least 20 days prior to scheduling the training.
H. Contractor shall coordination installation of mixing system with electrical installation of power and SCADA connections. Include all required conduit, cables, and connections.

3.02 SITE CLEANING:

A. The project site shall be kept in a clean and safe condition at all times. The Contractor shall remove all construction equipment and debris at project completion.

3.03 INSTALLATION

A. The CONTRACTOR shall furnish services of a factory-trained installation contractor or crew having experience with installation procedures and operation and maintenance requirements for the type of equipment installed under these specifications. Mixer must be able to be installed through a 12”x12” hatch. Mixer must be able to be installed without draining tank or taking tank out of service. Wet-side of Mixer shall weigh less than 40 pounds (~18 kg) and dry-side shall weigh less than 55 pounds (~25 kg). Both wet-side and dry-side shall able to be hoisted, installed, and/or removed by on-site personnel without additional equipment needed, and so that there is no crush hazard or entanglement hazard present, and so that weight of mixer on tank floor does not cause damage to interior coating.

B. Install tank penetration above tank water line, through the tank roof within 2-feet of the roof hatch. Cable position shall not interfere with the tank ladder.

   1. Fitting will be water tight and prevent moisture intrusion into tank.
   2. Fitting shall be 1” diameter fitting to allow cable to pass through.
   3. Provide strain relief (Kellum grips or approved equal) for power cable.

C. Installation of the in-tank (wet-side) components may be performed in any of the following ways:

   1. Installation below a hatch opening in a full tank utilizing the Mixer power cord.
   2. Installation by personnel with confined space training while the tank is drained and empty.
   3. Installation by tank manufacturer personnel during tank manufacture.

D. Installation of the outside-of-tank (dry-side) components may be performed by:

   1. Contractor according to the manual provided.
   2. The mixer and optional SCADA interface or control center shall be installed in accordance with approved procedures submitted and Manufacturer’s instructions supplied, unless otherwise approved in writing from the Manufacturer.

3.04 TANK DISINFECTION

A. The proposed chlorination method shall be communicated to the owner’s representative prior to disinfection. The owner shall be notified a minimum of three weeks in advance of proposed date of commencing tank disinfection. Water and sufficient pressure for flushing, cleaning, initial testing and disinfection shall be supplied by the Owner at no cost to the Contractor. However, Contractor shall be aware that after tank disinfection, the water used for disinfection may not be able to be placed into the water system and may need to be de-chlorinated and discharged from the tank. Any costs associated with de-chlorination and discharge from the tank shall be the sole responsibility of the Contractor.

3.05 FIELD QUALITY CONTROL

A. Field Inspections. Before acceptance of the installed equipment, the OWNER Staff shall have the opportunity to observe the equipment.

B. If access and operation of the valve meet the OWNER’s criteria, then the equipment will be accepted as installed.

3.06 NON-CONFORMING WORK

A. If access and operation of the equipment does not meet the OWNER's criteria, remedy the situation until the equipment meets the OWNER's criteria.

END OF SECTION

SECTION 11261

CHLORAMINE ANALYZER

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment and incidentals necessary to install a chlorine analyzer as specified herein.

1.02 QUALITY ASSURANCE

A. The equipment and material to be furnished under this Contract shall be free from defects.

1.03 REFERENCES

A. The following references apply:

1. American National Standards Institute (ANSI).
2. American Society for Quality Control (ASQC).
3. American Society of Mechanical Engineers (ASME).
4. American Society for Testing Materials (ASTM).
5. American Water Works Association (AWWA).
6. The Chlorine Institute (CI).
7. Institute of Electrical and Electronics Engineers (IEEE).
8. International Standards Organization (ISO).
9. National Electrical Code (NEC).
10. National Electrical Manufacturers Association (NEMA).
11. National Fire Code (NFC).
12. National Institute of Occupational Safety & Health (NIOSH).
13. Occupational Safety and Health Administration (OSHA).
14. Standard Fire Code (SFC).
15. Uniform Fire Code (UFC).
16. Texas Commission on Environmental Quality (TCEQ) Regulations: Texas Administrative Code Title 30, Chapter 290

1.04 SUBMITTALS

A. Submittals shall be as specified in the General Conditions, Special Provisions, and Section 01340.

B. Submit the following:

1. Sufficient information to show that the equipment meets this specification.

2. Electrical wiring diagrams as required for the installation.

3. Documentation demonstrating that the gas feeder manufacturer is certified to the international quality standards ISO 9001 for design, assembly and manufacture.

4. Manufacturer's catalog cut sheets are not acceptable.

1.05 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for the delivery, storage and handling of products in accordance with the manufacturer's recommendations.

1.06 WARRANTY REQUIREMENTS

A. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment shall fail during the warranty period, it shall be replaced and the unit restored to service at no expense to the Owner. Warranty shall be for a period of two years and begin on the Date of Final Acceptance.

1.07 SYSTEM START-UP

A. The chlorination equipment manufacturer shall furnish the services of a qualified field engineer to check installation, start-up and instruct operating personnel in the proper operation and maintenance of the equipment.

PART 2 – PRODUCTS

2.01 CHLORINE ANALYZER

A. Coordinate with the City to select preferred chlorine analyzer. Startup services shall be provided by the manufacturers representative.

B. The chlorine analyzer shall have a 4-20mA output for SCADA interface.

C. Analyzer shall have a detection range of 0 to 5 mg/L free or total residual chlorine.

2.02 AMMONIUM ANALYZER

A. Coordinate with the City to select preferred ammonium analyzer. Startup services shall be provided by the manufacturers representative.

B. The chlorine analyzer shall have a 4-20mA output for SCADA interface.

C. Analyzer shall have a detection range of 0 to 1,000 mg/L.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Chlorine and ammonium analyzers shall be installed in accordance with the instructions of the manufacturer. Installation and adjustment shall be checked and approved by a manufacturer's factory representative.

END OF SECTION

SECTION 11262

GAS CHLORINATION EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE

A. Furnish, Install, test and place in satisfactory operation, all of the chlorine gas feed equipment, accessories, and materials as directed by the plans and following specifications.

1.02 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work performed under this Section.

1.03 REFERENCES

A. Chlorine Manual, The Chlorine Institute, Inc., Washington, D.C.

1.04 QUALITY ASSURANCE:

A. Manufacturer to provide the latest and most current and proven design of the equipment, compatible with the functions required herewith.
B. Components shall be furnished with manufacturer's standard for service intended.
C. Contractor to coordinate the work schedule of the manufacture's service personnel during construction, testing, start-up and acceptance.
D. Provide services of factory-trained service technician, specially trained on the equipment provided.

1.05 SUBMITTALS:

A. Submit shop drawings product data under provisions of Section 01300 at the appropriate time.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Submit operation and maintenance manuals as is required by Section 01730 at the appropriate time.

PART 2 - PRODUCTS

2.01 CHLORINATION EQUIPMENT:

A. Automatic Chlorinator:

1. Provide (2) JCS Model 4200-100 Automatic Gas Feeders for Chlorine gas rated to 100 PPD.
   a) The automatic chlorinator shall be provided with glass rotameter tube, programmable process controller, auto positioning V-notch, LED display with membrane pushbuttons, and manual override.
   b) The gas chlorinator shall have an accuracy of ±4% over full scale and shall have a turn down of 20:1.
   c) The gas chlorinator shall be able to take a signal from the plant PLC, flow meter, residual analyzer, or a compound loop input and automatically adjust to the desired dosage. The chlorinator shall provide the following inputs; 4-20 mA analog, digital call to service.

d) The chlorinator shall provide the following outputs; 4-20 mA Valve position, digital status indicators, RS232 interface. The unit shall come with an integral battery backup to provide continuous use in the event of a power failure.
e) Provide (1) Spare kit for each automatic gas chlorinator supplied.

B. Vacuum Regulator (Automatic Switchover):

1. Provide (2) JCS Model 420-VRC-Cl2 Vacuum Regulator that mount directly to 150 lb cylinders of chlorine gas.
   a) The units shall be designed for automatic switchover so that when the primary cylinder is almost empty, the second standby cylinder will be brought into service along with the original cylinder.
   b) Each vacuum regulator shall include safety vent connection to vent chlorine outside of the chlorine room in the event of malfunction.
   c) Provide (1) Spare Parts Kit per regulator.

C. Vacuum Ejector:

1. Provide (2) JCS Model 420-INJ-12 Vacuum
   a) Ejectors located adjacent to each vacuum feeders.
   b) Ejector Throat and tailway shall be sized to operate against a back pressure of psig at the point of injection, a water supply velocity of gpm, and a water supply pressure of (60) psig at the inlet of the vacuum ejector.
   c) The Vacuum Ejector shall pull up to 100 PPD of chlorine gas under these conditions.
2. Provide (1) Spares Parts kit for each vacuum ejector provided.

D. Chlorine Gas leak Detector:

1. Provide (1) JCS Model 4500-D-Cl2 DUAL Channel Chlorine Leak Monitor(s).
   a) The chlorine leak monitor shall be provided with (1) controller and (2) leak sensors per unit. The leak sensors shall have a range of 0-10 PPM of chlorine gas.
   b) The controller shall alarm out in the event of a leak to the plant dialer, alarm system, or an emergency closure system if installed.
   c) The controller shall output individual 4-20 mA signals for each channel of the leak detector and shall contain an integral battery backup to provide continuous use in the event of a power failure.

E. Electronic Dual Cylinder Scale:

1. Provide (1) JCS Model 4700-D Dual Electron Cylinder Scale to display the weight of 150# compressed gas cylinders.
   a) Each unit shall be designed with (1) controller, and (1) dual scale platform. Each platform shall be designed to be weather resistant and support up to 300 pound.
   b) The controller shall send a 4-20 mA signal to the plant PLC for each platform. Each system shall be provided with stainless steel wall brackets and chain to safely secure the compressed gas cylinder while in service.
   c) The unit shall come with an integral battery backup to provide continuous use in the event of a power failure.

F. Emergency Shutoff Valves:

1. Provide (2) JCS Model RC150 Emergency Shutoff Actuators designed to function on 150# cylinders of compressed gas.
   a) The Actuator system shall be controlled by (1) JCS Model RCP006RCC Actuator Control Panel/s.
   b) The actuator enclosures shall be NEMA 4X rated and designed to withstand exposure to corrosive gasses.
   c) The system shall be 12 Volt DC battery powered with an onboard battery charger to prevent loss of function in a power failure.
   d) The actuators shall engage when signaled by either the plant PLC, external leak detectors, or emergency panic buttons.
   e) The Actuators shall be programmable to open at 90, 180, 270, or 360 degrees.
   f) Control panel shall include power status light and mushroom style emergency pushbutton.
2. Provide(1) JCS Model RPB001 Emergency Panic Button/s and (1) spare battery.

2.02 SAFETY EQUIPMENT:

A. SCBA: Provide (1) Scott 30 Minute SCBA and facemask. Provide (1) FRP Wall Case.

2.03 PIPING, VALVES, AND ACCESSORIES

A. Diffuser: Provide (1) Saf T Flo Model EB-132-B-P-6-0 Corp Stop Diffusers. Corporation Stop shall be constructed of a Brass 1" NPT Corp, and ½" SCH 80 PVC Solution tube.
B. Solenoid Valve: Provide (2) ASCO 8210G009 solenoid valve(s) without integral bypass

1. Solenoid valve shall open upon receiving relay signal from well control panel signifying that the well pump is operating.
2. Provide piping and valves to bypass the solenoid valve in the event of a malfunction.

C. Pipe Material: Provide schedule 80 PVC piping and fittings, rated for a minimum pressure of 400 PSIG at 73 degrees F. As far as practicable, all joints to be solvent weld socket type. Where threaded joints are necessary to transition to equipment, joints to be made using Teflon tape jointing material. Minimum piping size to be 3/4 inch.
D. Valves:

1. Ball Valves: SimTech Tru-union PVC Ball Valves, Viton fitted.
2. Ball Check Valves: SimTech Tru-union PVC Ball Check Valves, Viton fitted.

E. Pipe Clamps: Cobra nonmetallic clap. Attach using 316 stainless steel fasteners.
F. Safety Chains: Provide 316 stainless steel safety chains for two on-line chlorine gas cylinders. Provide 316 safety chains for four (4) full 150 pound cylinders and four (2) empty 150 pound cylinders.
G. Safety Signs: Provide one (1) "DANGER - CHLORINE GAS" safety sign on the door to the chlorine gas equipment room.
H. Wye Strainer: Provide (1) PVC Wye Strainer and install on motive water line.
I. Pressure Gauges: Provide (1) ½" NPT 0-160 psig pressure gauge, with PVC/TEF Diaphragm.
J. Miscellaneous:

1. Provide (50) Lead Gaskets for chlorine cylinders.
2. Provide (1) Bottle 26 degree Baume Ammonia used to test for chlorine leaks.

PART 3 - EXECUTION

3.01 INSTALLATION AND TESTING:

A. Install all equipment and connecting piping in accordance with manufacturer's instructions. Prior to testing and start-up, inspect to verify the system is complete.
B. No form of energy shall be turned on to any part of the system prior to approval of factory authorized service representative.
C. Clean all new piping prior to testing.
D. After installation, and in the presence of the Engineer, test all pipelines for tightness in acceptable manner. Furnish suitable testing plugs or caps, all necessary pipe connections, test fluids, gauges or other equipment and all labor required.
E. Test for chlorine leaks with commercial 26 degree Baume Ammonia.
F. After installation of equipment in the presence of the Engineer, operate each unit to demonstrate its ability to operate without leakage and to perform its specified functions satisfactorily.

END OF SECTION

SECTION 11263

LIQUID AMMONIA SULFATE
FEED EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE

A. Furnish, Install, test and place in satisfactory operation, all of the chlorine gas feed equipment, accessories, and materials as directed by the plans and following specifications.

1.02 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work performed under this Section.

1.03 REFERENCES

A. Chlorine Manual, The Chlorine Institute, Inc., Washington, D.C.

1.04 QUALITY ASSURANCE:

A. Manufacturer to provide the latest and most current and proven design of the equipment, compatible with the functions required herewith.
B. Components shall be furnished with manufacturer's standard for service intended.
C. Contractor to coordinate the work schedule of the manufacture's service personnel during construction, testing, start-up and acceptance.
D. Provide services of factory-trained service technician, specially trained on the equipment provided.

1.05 SUBMITTALS:

A. Submit shop drawings product data under provisions of Section 01300 at the appropriate time.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Submit operation and maintenance manuals as is required by Section 01730 at the appropriate time.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

A. Liquid Vacuum Feeders:

1. Provide (2) JCS Model 4100-200 Automatic Liquid Vacuum Feeders.
   a) The automatic Liquid Vacuum Feeders shall be comprised of; and programmable microprocessor controller with LED display and membrane pushbuttons, inline flow meter, and an auto positioning v-notch valve.
   b) The unit shall have an accuracy of ±2% of actual feed rate and have a turn down of 100:1.

c) The unit shall accept the following inputs: 4-20 mA analog, digital call to service. The unit shall provide the following outputs: 4-20 mA Valve position, 4-20 mA instantaneous flow rate, digital status indicators, RS232 interface.
d) The unit shall be capable of the following control modes, fixed feed, flow, residual control, compound loop, feed forward. The unit shall have an integral battery backup.

2. Provide (1) spare part kit with each unit.

B. Vacuum Ejector:

1. Provide (2) Model 484 vacuum ejector.
2. The ejector shall be constructed of Polypropylene and include an integral check valve.
3. The ejectors shall be sized to feed operate against a back pressure of psig at the point of injection, with a water supply velocity of gpm, and a water supply pressure of psig at the inlet of the vacuum ejector.
4. Provide (1) spare part kit with each unit.

C. Double Walled XLPE Storage Tank:

1. Provide (1) 250 gallon double walled storage tank.
   a) Storage tank shall be suitable for 38% liquid ammonia sulfate Solution.
   b) The fittings of construction shall be SCH 80 PVC, the gaskets shall be Viton.
   c) Fitting Schedule:
      i) (1) 2” Fill Line Assembly
      ii) (1) 1” Containment Drain
      iii) (1) 2” Self-aligning bulkhead fitting for ultrasonic level indicator
      iv) (1) 4” Mushroom Vent
2. The doubled walled storage tank shall be in accordance with the TCEQ Double-Wall Spill Containment Tanks Required Conditions. All penetrations to the inner tank must be through the top of the tank; no sidewall penetrations will be accepted.

D. Ultrasonic Level Indicator:

1. Provide (1) JCS Model 4600-L Ultrasonic Level Indicator(s).
   a) The level indicator shall be comprised of (1) controller and (1) level transducer.
   b) The unit shall be capable of level detection up to 13 feet.
   c) The unit shall include two adjustable alarms, 4-20 mA output of the liquid level, data logger, totalizer, and integral battery backup.

E. Mono-chloramine Analyzers

1. Provide (1) Swan Model Codes CC Mono-Chloramine Analyzers, and (1) Swan Model AMI Universal Ammonia Analyzers
   a) Analyzers to be provided with:
      i) (1) Wye Strainer
      ii) (1) Pressure Reducing Valve
2. Provide (1) Analyzer Sample Return System that include:
   a) 40 Gallon Single Wall Tank

b) Level Switch
c) 1/2 HP Sample Return Pump

F. Booster Pump: Provide (2) Franklin Motors 1VR-11-00stg-1.5HP vertical multi stage booster pump. Booster pump shall be single phase, 1.5 HP, with 316 Stainless Steel pump head.

G. Piping, Valves, and Accessories

1. Diffuser: Provide (1) Saf T Flo Model EB-132-B-P-6-0 Corp Stop Diffusers. Corporation Stop shall be constructed of a Brass 1" NPT Corp, and ½" Sch 80 PVC Solution tube.
2. Solenoid Valve: Provide (2) ASCO 8210G009 solenoid valve(s) without integral bypass
   a) Solenoid valve shall open upon receiving relay signal from well control panel signifying that the well pump is operating.
   b) Provide piping and valves to bypass the solenoid valve in the event of a malfunction.

H. Pipe Material: Provide schedule 80 PVC piping and fittings, rated for a minimum pressure of 400 PSIG at 73 degrees F. As far as practicable, all joints to be solvent weld socket type. Where threaded joints are necessary to transition to equipment, joints to be made using Teflon tape jointing material. Minimum piping size to be 3/4 inch.

I. Valves:

1. Ball Valves: SimTech Tru-union PVC Ball Valves, Viton fitted.
2. Ball Check Valves: SimTech Tru-union PVC Ball Check Valves, Viton fitted.

J. Pipe Clamps: Cobra nonmetallic clap. Attach using 316 stainless steel fasteners.

K. Safety Signs: Provide one (1) "DANGER – LIQUID AMMONIA SULFATE" safety sign on the door to the liquid ammonia sulfate equipment room.\

L. Wye Strainer: Provide (1) PVC Wye Strainer and install on motive water line.

M. Pressure Gauges: Provide (1) ½" NPT 0-160 psig pressure gauge, with PVC/TEF Diaphragm.
   a) The unit shall come with an integral battery backup to provide continuous use in the event of a power failure.

PART 3 - EXECUTION

3.01 INSTALLATION AND TESTING:

A. Install all equipment and connecting piping in accordance with manufacturer's instructions. Prior to testing and start-up, inspect to verify the system is complete.
B. No form of energy shall be turned on to any part of the system prior to approval of factory authorized service representative.
C. Clean all new piping prior to testing.

D. After installation, and in the presence of the Engineer, test all pipelines for tightness in acceptable manner. Furnish suitable testing plugs or caps, all necessary pipe connections, test fluids, gauges or other equipment and all labor required.
E. After installation of equipment in the presence of the Engineer, operate each unit to demonstrate its ability to operate without leakage and to perform its specified functions satisfactorily.

END OF SECTION

SECTION 11296

ALTITUDE VALVE ASSEMBLY

PART 1 - GENERAL

1.01 SCOPE

A. Contractor shall furnish, install and place into satisfactory operation the altitude valve assembly shown in the drawings.
B. Coordinate installation of altitude valve with Owner and Manufacturer's Representative to ensure correct operation.

1.02 REFERENCES

A. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
B. American Society of Mechanical Engineers (ASME):
C. ASTM International (ASTM):

1. A322: Carbon and Allow Steel Bar
2. A507: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled

D. American Gear Manufacturers Association (AGMA)
E. American Bearing Manufacturers Association (ABMA)
F. American Institute of Steel Construction (AISC)
G. American Welding Society (AWS)
H. American Structures Painting Council (ASPC)

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01300.
B. All submittals shall be approved by the Owner in writing prior to delivery and fabrication for specials.
C. Submittals shall describe all required equipment, dimensions, electrical connections, piping connections, and sufficient performance data to determine compliance with design intent.

1.04 WARRANTY:

A. The valve manufacturer shall warrant the valve to be free from defects in design, workmanship, and materials, provided the valve is installed and used in accordance with all applicable instructions. Warranty shall be for a period of three (3) years from the date of shipment. If any part of the equipment should fail during the warranty period, it shall be replaced and the unit(s) restored to service at no expense to the City.

1.05 OPERATION AND MAINTENANCE MANUALS

A. Provide three bound hard copy Operation and Maintenance Manuals.
B. Manuals shall include complete equipment data, operation requirements, storage, trouble shooting, spare parts list, equipment list, drawings, and catalog sheets.

C. Manual shall include preventative maintenance table identifying all parts and materials required and recommended frequency of maintenance.
D. Provide electrical drawings for all control panels showing all necessary field connections to be made.

1.06 TESTING

A. Begin start up and testing of screw press be started as soon as possible after installation and after all components operable.
B. Demonstrate operation of unit to complete normal start, normal stop, and emergency stop cycles.
C. Submit screw press to an 8-hour minimum running test:

1. At beginning and end of test, and at one-hour intervals between, check:
   a) Pressure gauges
   b) Flow indicators
   c) All safety devices
   d) Differential speed control
   e) All instruments and controls
2. Check no load amperage of motor.
3. Perform tests run by seller's authorized representative with assistance from Manufacturer.
4. Submit all test readings to Engineer in writing.
5. Correct all malfunctions and retest as directed by Engineer, until equipment is operating properly:
   a) Each retest shall be for the specified eight-hour period.
6. Supplier/Seller to certify in writing that screw press is ready for performance testing.

1.07 WARRANTY

A. Provide Owner with written warranty for period of one year from the date of startup. If equipment should fail during the warranty period, Contractor shall return unit to operational service at no cost to Owner.

PART 2 - PRODUCTS

2.01 SCOPE OF WORK:

A. Provide an altitude and solenoid shut-off valve with return flow. Furnish all materials, equipment, labor and incidentals necessary to provide, install and put into operation one altitude valve as specified herein and shown on the drawings.

2.02 REFERENCES:

A. American Society for Testing and Materials (ASTM).

1. ASTM A48 Gray Iron Castings.
2. ASTM A126 Gray Iron Castings for Valves, Flanges, and Pipe Fittings
3. ASTM A436 Austtenitic Gray Iron Casting
4. ASTM A536 Ductile Iron Casings.

B. NSF/ANSI Standard 61

2.03 SYSTEM DESCRIPTION:

A. The solenoid control valve is a self-contained unit consisting of a diaphragm-operated packless valve, a diaphragm-operated high capacity auxiliary valve and a packless three-way solenoid pilot valve. The valve shall either open wide or close drip tight. The three-way solenoid pilot alternately applies pressure to or exhausts pressure from the diaphragm chamber of the high capacity auxiliary valve which in turn causes the same action in the main valve. The valve is designed for two-way flow. When the valve outlet pressure (tank) exceeds the inlet (distribution) pressure, the valve will allow return flow.

B. This valve shall control the high water level in the elevated tank without the need for floats or other devices. It shall be a non-throttling type valve and remain fully open until the "shut-off" point in the reservoir is reached. This valve is designed for two-way flow and shall have a solenoid to override the altitude pilot causing valve closure. The valve shall be designed to shut off at the normal high level set point and return flow to the system under normal operating conditions. Upon receiving an electrical signal to the solenoid, the valve shall close at a controlled rate to prevent water from entering into the reservoir. The valve shall be normally closed and energized to open.

C. The arrangement shown on the drawings is based upon the best information available to the Engineer at the time of design and is not intended to show exact dimensions to any specific equipment unless otherwise shown or specified. Therefore, it may be anticipated that the structural supports, foundations, and connected piping shown, in part of in whole, may have to be changed in order to accommodate the equipment furnished. No additional payment will be made for such changes. All necessary calculations and drawings for any related redesign shall be submitted to the Engineer for his approval prior to beginning the work.

2.04 QUALITY ASSURANCE:

A. The valve shall be the product of a manufacturer regularly engaged in the manufacture of hydraulic valves having similar service and size. The valves covered by the specifications are intended to be standard equipment of that has proven ability. Only the following manufacturers and models are acceptable.

2.05 MANUFACTURER

A. The following mixing equipment manufacturer has been preapproved:

	Manufacturer	Model	Contact Information
B.	Cla-Val	133-AW Altitude Valve	907 S Friendswood Dr, Ste. 203 Friendswood, TX 77546 (281) 638-0304
C.	Cla-Val	X43H Strainer	same
D.	Cla-Val	Series 584 Check Valve	same
E.	Cla-Val	VC-22D Electronic Valve Controller	same

F. Any product that is not listed above is considered a substitution and shall be submitted in accordance with Section 01630. Substitutions must comply with the requirements of this specification.

G. All other valves will be considered a substitution, and will be required to submit a substitution form as specified in Section 01630. The Engineer shall be the sole judge of the acceptability of any substitution requested. If the substitution request is found to be unacceptable by the Engineer then the contractor shall provide the listed equipment at no additional expense to the owner. The Contractor shall be responsible for any delays as a result of a substitution request.

H. The listing above does not imply that the manufacturer's standard product is acceptable. The successful manufacturer will be required to conform to all specifications.

I. The valve manufacturer shall be able to supply a complete line of equipment from 1 ¼" through 24" sizes and a complete selection of complimentary equipment.

J. The valve manufacturer shall also provide a computerized cavitation chart which shows flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage. The valve manufacturer shall be able to provide cavitation analysis substantiated by independent third party testing. A direct factory representative shall be made available for start-up service, inspection, and necessary adjustments. Valve shall meet NSF/ANSI Standard 61.

K. Unit Responsibility and Coordination: The Contractor shall cause all equipment specified under this section to be furnished by the valve manufacturer who shall be responsible for the adequacy and compatibility of all unit components including but not limited to the valve, actuator and extension stems. Any component of each complete unit not provided by the valve manufacturer shall be designed, fabricated, tested, and installed by factory-authorized representatives experienced in the design and manufacture of the equipment. This requirement, however, shall not be construed as relieving the Contractor of the overall responsibility for this portion of the work.

2.06 SUBMITTALS:

A. Submittals required after award of contract and prior to shipping:

B. Technical bulletins and brochures.

C. Certification of compliance with specifications.

D. Submittals required prior to final walk through:

1. Operation and Maintenance Manual.

2.07 SPARE PARTS AND TOOLS:

A. None required.

2.08 MAIN VALVE:

A. The valve shall be hydraulically operated, single diaphragm actuated, globe pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

B. No separate chamber shall be allowed between the main valve and body. Valve body and cover shall be of cast material manufactured and machined in North America. No fabrication or welding shall be used in the manufacturing process. The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass-shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

C. The diaphragm assembly containing a non-magnetic 303 stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid.

D. The diaphragm must withstand a Mullins burst test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position.

E. The main valve seat and the stem bearing in the valve cover shall be removable. Valve seat in eight inch and larger size valves shall be retained by flat head machine screws for ease of maintenance. The seat shall be of the solid, one piece design and shall have a minimum of a five degree taper on the seating surface for positive drip tight shut-off. Pressed-in bearings and/or multi-piece seats shall not be permitted. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.

2.09 PILOT CONTROL SYSTEM:

A. The pilot control shall be a three-way solenoid valve controlled by an external electrical power source. The pilot system shall include strainers, shut-off cocks and manual operator. Opening and closing speed control needle valves shall be utilized so as to prevent surging of the system on start-up and shut down. Solenoid shall have a NEMA IV enclosure. Valve shall include a X105LCW Limit Switch for open/closed indication.

2.10 MATERIAL SPECIFICATION FOR PILOT CONTROL:

A. Body & Cover: Cast Brass ASTM B62

B. Pressure Rating: 300 psi
C. Trim: 303 Stainless Steel
D. Rubber Material: Buna “N”
E. Tubing and Fittings: Bronze & Copper
F. Operating Fluids: Potable Water
G. Voltage: 120/60 Volt AC
H. Enclosure Type: Nema IV Watertight

PART 3 - EXECUTION

3.01 SHIPPING INSTRUCTIONS:

A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
B. All equipment and parts must be properly protected against any damage during a prolonged period at the site.
C. The finished surfaces of all exposed flanges shall be protected by wooden blank flanges, strongly built and securely bolted thereto.
D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
E. Storage and Protection: Take special care to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, preventing any deformation.

3.02 INSTALLATION:

A. The valve shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings.
B. Installation and adjustment shall be checked and approved by a manufacturer's direct factory representative. After acceptance, the representative shall address a letter to the Engineer outlining all installation and start up procedures. The letter shall include a statement that the valves are installed per the manufacturer's recommendations. The manufacturer or his qualified representative shall conduct training session for the Owner's personnel in the operation and maintenance of the valves.
C. The valve manufacturer shall provide a direct factory representative to calibrate the valve and verify operation during start up.

END OF SECTION

Section 13400

Measurement and Control Instrumentation

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. This section covers field transmitters for instrumentation and control systems. Refer to complete plans and project manual for additional information on all transmitters described to be provided and installed

1.02 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.03 QUALITY ASSURANCE

A. All equipment shown to be provided and installed shall be coordinated with each manufacturer for accuracy and relevance. Manufacturer shall be included in all testing, calibration, and substantial walkthrough prior to engineer final walkthrough

PART 2. PRODUCTS

2.01 ELECTRONIC PRESSURE GUAGE TRANSMITTER

A. Manufacturers:

1. Foxboro.
2. Rosemount.
3. Danfoss
4. Or pre-approved equal.

B. Electromechanical device to produce analog current signal as function of pressure input to it.

C. Mounting: Universal bracket for 2 in. pipe mounting.

D. Housing: Threaded, metal NEMA 4.

E. Connections: 1/2 in. NTP.

F. Wetted Parts: Type 316 stainless steel.

G. Calibration Capability: Gauge, vacuum, and absolute.

H. All readouts to be actual unit values and not percent scale.

I. Output: 4 20 mA

J. Adjustments: Zero and span, for 5:1 rangeability.

K. Power: 24 to 45 VDC.

L. Accuracy: ±0.5% of span.

M. Accessories:

1. Weatherproof integral output indicator 0% to 100% linear.
2. Zero elevation/suppression of at least 100% of span.

N. Type: IGP20 Pressure Transmitter

O. Pressure Range: 0-150 psi (for water facility applications).

2.02 DIFFERENTIAL PRESSURE MONITORING DEVICE

A. Manufacturers:

1. Foxboro.
2. Rosemount.
3. Or pre-approved equal.

B. Differential capacitance open loop principle device to produce analog current signal as function of differential pressure input to it.

C. Mounting: 2 in. pipe mounting bracket.

D. Housing: Threaded, metal NEMA 4.

E. Wetted Parts: Type 316 stainless steel with 1/2 in. NPT connections.

F. Output: 4-20 mA

G. Adjustments: Span with external zero.

H. Power Required: 24 to 45 VDC.

I. Accuracy: ±0.5% of span.

J. Construction: Explosion-proof, FM approved for Class I, Division 1 service.

K. Accessories:

1. Type 316 stainless steel, 3 valve manifolds to provide transmitter isolation and equalization.
2. Weatherproof integral output indicator 0% to 100% linear.

L. Provide integral square root extractor for differential pressure flow monitoring applications

M. Provide diaphragm seal on transmitters at hydro tanks where corrosive chemicals are present or in water.

N. Pressure Range: 0-150 psi (for water facility applications).

2.03 ELECTRONIC FLANGE MOUNTED LEVEL TRANSMITTER

A. Manufacturers:

1. Foxboro.
2. Rosemount.
3. Or pre-approved equal.

B. Differential capacitance open loop principle device to produce analog current signal as function of liquid level input to it.

C. Mounting: 150 lb flange mount.

D. Housing: Threaded cover, metal, NEMA 4.

E. Wetted Parts (Process Side): Flush mount, Type 316 stainless steel diaphragm.

F. Water Span Adjustment: 20 to 200 in., 160 to 785 in. water.

G. Provide elevation/suppression kit.

H. Output: 4-20 mA

I. Adjustments: Zero, span, and dampening.

J. Accuracy: ±0.25% of span.

K. Construction: Explosion-proof, FM approved for Class I, Division 1 service (see specification for requirement).

L. Accessories: Weatherproof integral output indicator scaled 0% to 100% linear, with input.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved submittals.

B. Set-up and calibration of equipment shall only be performed by a Factory Technician.

C. Provide diaphragm seal for all pressure transmitters that are used for measuring liquid level at hydro tanks and for all pressure transmitters measuring corrosive liquids or gasses. For high temperature air, gas or liquid measurements, install isolation diaphragm seal near pipe tap and provide extension piping to transmitter located remotely from heat source.

D. For all differential level transmitters used to measure level of hydro tanks, provide a diaphragm seal at the top connection to the hydro tank to prevent water entry into

the transmitter. Unit shall be rated for the pressure range of the transmitter and shall be stainless steel construction.

3.02 ADJUSTEMENT/CALIBRATION

A. Provide services of a Factory Technician for calibration and programming of transmitters for range of variable with 4/20 mA representing 0 to 125 percent of maximum range. Allow for field adjustments during testing of installation

3.03 MAINTENANCE/WARRANTY

A. Contractor shall provide full 3-year service warranty on the overall installation and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning

B. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract.

C. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.

D. Any failed equipment may not be repaired and returned to service prior to final acceptance. Only new equipment is allowed.

E. For all differential level transmitters used to measure level of hydro tanks, provide a diaphragm seal at the connection to the hydro tank to prevent water entry into the transmitter. Unit shall be rated for the pressure range of the transmitter and shall be stainless steel construction.

END OF SECTION

Section 13420

Flow Meter (Magnetic)

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor's expense

D. Section Includes:

1. Magnetic Flow Meters
2. Signal Converters
3. Interconnecting Cable

1.02 SYSTEM DESCRIPTION

A. The magnetic flowmeter shall be microprocessor-based and flanged. It shall indicate, totalize, and transmit flow in full pipes.

B. The flow meter signal converter shall have a 16-character backlit alphanumeric display that indicates user-defined flow units and total flow.

C. Ratio of flow velocity to reference voltage signals generated identical for each meter size. Meter shall be compatible with secondary readout instrument and with SCADA System input without circuit modifications.

D. Coordinate the flow meter ranges with the related equipment manufacturer or as specified

E. Changes in density, viscosity, temperature, pressure, or conductivity within limits of flow meter shall not affect accuracy. Maintain accuracy for field repairs performed by supplier's service technician during warranty period.

F. Totalized flow and programmed configuration shall be maintained in memory for the meter's lifetime.

G. The meter shall be capable of storing flow data during loss of power, via a backup battery supply, without loss of data.

H. The meter shall have password protection for access.

I. Power requirements: 120 Vac, 60 Hz.

1.03 SUBMITTALS

A. The following information shall be included in the submittal for this section:

1. Data sheets and catalog literature for each meter and converter
2. Standard wiring diagrams
3. Interconnection and dimensional drawings
4. Spare parts list and optional accessories
5. Drawings showing location of meter in pipe system
6. Wiring diagram between meter, converter, recorder, and SCADA system

B. Operation and Maintenance (O&M) Data: Hydraulic calibration results including printout of actual calibration data giving indicated vs. actual flows at minimum of 1 ft/sec flow rate for each meter. Identify results by serial number of each meter.

C. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

PART 2. PRODUCTS

2.01 MANUFACTURER’S

A. Badger
B. Endress + Hauser
C. Foxboro
D. Krohne
E. McCrometer
F. Rosemount
G. Or pre-approved equal

2.02 FLOW METER

A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Meters shall be capable of bidirectional flow and totalize for forward, reverse and net totals.

B. The flow tube shall be provided with Nickel Alloy (Hastelloy C) or 316 SS flush mounted electrodes, as shown on schedule. Ultrasonic electrode cleaning shall not be acceptable.

C. Grounding rings shall be provided for all meters. The use of grounding electrodes is not acceptable.

D. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.

E. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of 30 to +65oC. Meter and transmitter housings shall meet NEMA 4X requirements as a minimum. When mounted in a meter vault (or otherwise specified), flow tube shall be of IP 68 construction as installed by the factory (no field IP 68 installation allowed). When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas. Non-metallic transmitter housings shall not be acceptable.

F. The measuring system shall consist of a transmitter and a sensor.

G. The flow meter shall have the option for remote and local transmitter locations.

H. Connections shall be Class 150 ANSI flanged construction.

I. Accuracy -+0.5 percent.

J. Output:

   a. Modbus RTU
   b. 4-20 mA
   c. Modbus TCP/IP

2.03 SIGNAL CONVERTER

A. Remote or integrally mounted, microprocessor controlled.

   1. Operate on 120 vac, 60 Hz power.
   2. Provide pulsed dc voltage to magnet coils of magnetic flow meter to establish magnetic field.
   3. Convert flow signal from magnetic flow meter to analog and digital output signals, for bidirectional flow.

B. Span to be continuously adjustable between approximately 2 and 31 ft/sec. Adjustment shall be by keypad.

C. The transmitter shall be remote mounted and have a polyurethane painted dual compartment aluminum, NEMA 4X housing.

D. The transmitter shall utilize a 120 VAC power supply and have signal outputs including Modbus RTU, Modbus TCP/IP, and 4-20 mA.

E. The transmitter shall be capable of communicating digitally with a remote configuration device via Modbus RTU. A security lockout feature shall be provided to prevent unauthorized modification of configuration parameters

2.04 CABLE

A. Provide sufficient length of signal cable as standard with manufacturer, to connect meter and converter. Cable shall be supplied by the manufacturer unless otherwise noted.

B. Use double conduit run between converter and meter when installed at separate locations.

2.05 SOURCE QUALITY CONTROL

A. Each flow tube shall be factory calibrated in an ISO 9001 and NIST certified facility and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in nonvolatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.

B. Wire and test meter, suitable for operation.

C. Instruments shall be purchased only from local suppliers that are factory-recognized representatives. No exceptions. Contact local Factory Representatives for additional information.

D. Meter shall be capable of communicating to multiple master sites via port multipliers or built in dual outputs on the meter.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved submittals.

B. Locate meter as recommended by manufacturer with respect to other piping components to ensure meter will meet specified accuracy. Before ordering flow meter, perform field survey to assure location will provide satisfactory operation. Install only flow sensor in vault (when applicable) and install transmitter, convertor and power supply in control panel, or as shown otherwise on Plans. Ground magnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.

C. Manufacturer’s Representative shall verify flow meter specified is suitable for application and location.

D. Manufacturer Representative shall field test installation and check calibration accuracy and shall provide written report for Engineer’s review.

E. Verify installation arrangement with Engineer before starting work.

F. The flow meter shall be installed where directed by the ENGINEER and connected with other system elements and placed in successful operation. It shall be provided

with input power and output signal transient protection, associated control elements as specified herein and in accordance with manufacturer's instructions.

G. Services of Manufacturer's Representative

1. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided as specified herein. Qualifications of the representative shall be submitted for approval. Workday requirements listed are exclusive of travel time and do not relieve the CONTRACTOR of obligation to provide sufficient service to place equipment in satisfactory operation.

Services Provided by Factory Representative	Minimum[a] No. of Trips	Minimum Time on Site Per Trip (hours)
1. Supervise installation	1	4
2. Inspect and approve installation[b]	1	2
3. Supervise initial adjustment[c]	1	2
4. Supervise and assist in testing[d]	1	4
5. Instruct Owner and Engineer in proper start-up and O&M[e]	1	1

a. The manufacturer's factory representative shall be present at frequent enough intervals to ensure proper installation, testing, and initial operation of the equipment.

b. The manufacturer's factory representative shall provide to the Engineer a written certification that the system has been installed in accordance with the manufacturer's recommendations.

c. May be done upon completion of Item 2 if acceptable to the Engineer.

d. May be done upon completion of Items 2 and 3 if acceptable to the Engineer.

e. Instruction may be given upon completion of Item 4, provided that the test is successful, and the O&M manuals have been submitted to and accepted by the Engineer.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Manufacturer's Representative Technician for equipment specified herein shall be present at job site for assistance during plant construction, plant startup, equipment calibration, and for training of Owner's personnel for instrument operation.

2. Manufacturer's Representative Technician shall be present for final acceptance testing of instruments.
3. AMS Intelligent Device Manager Software shall be available to configure parameters, run diagnostics, and provide meter documentation. Calibration and service reports shall be provided to the contractor and owner.
4. There are no exceptions to this requirement, however, a factory trained, certified Manufacturer's Representative Technician experienced with specific instrument may provide services described in No. 1 and 2 above, where pre-approved in writing.

3.03 WARRANTY

A. Provide three (3) year warranty from date of acceptance, covering all parts, labor, and incidental costs

END OF SECTION

Section 16004

Electrical Systems Testing and Startup

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. Requirements for electrical system testing and startup are included in this section.

1.02 REFERENCES

A. National Electrical Codes (NEC): NEC Article 110 - Requirements for Electrical Installations.

B. International Electrical Testing Association (NETA): “NETA Acceptance Testing Specifications.”

1.03 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

B. The name, address, and telephone number of the proposed testing company to be engaged for testing the electrical system, together with their references and samples of recent test results and reports

C. The Contractor shall submit for approval a complete list, including catalog data and descriptive matter, of all products and equipment the Contractor proposes to furnish, and details as may be required by the Engineer to review proposed testing methods. At a minimum, the following are required.

1. Samples of proposed test report forms for the various types of tests indicated herein prior to commencement of field testing.
2. Test reports shall include but not be limited to the following: date, testing personnel names, temperature and humidity, description of item tested, type of tests performed, equipment used for testing, and test results.

PART 2. PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND PERSONNEL

A. The Contractor shall provide the following:

1. Qualified personnel to conduct all testing.
2. Labor, temporary power, lighting, wiring, and materials required for testing.

3. Submit nameplates and label legends as required in Section 16075 - Electrical Identification. All abbreviations and titles shall be checked for clarity.

B. Test Equipment: The third party testing agency shall furnish all test equipment, which shall include but not be limited to the following:

1. Wet and dry bulb thermometer.
2. Meggers by James G. Biddle Co., or Associated Research, Inc., or approved substitution, suitable for 120, 208, 240, and 480 volt and systems testing. Use instruments rated at voltages recommended by Material and Equipment Manufacturers.
3. Portable radios.
4. A Simpson Model 260 Volt-Ohm-Millimeter, or approved substitution.
5. A phase sequence and rotation meters rated at 600 volts, 30-60 hertz, by Knopp, Inc., or approved substitution for the 120, 208, 240, and 480-volt systems.
6. A commercial model, three point, ground test by James G. Biddle Co., a "Vibroground" tester by Associated Research, Inc., or approved substitution.

C. The Contractor shall furnish and use safety devices such as rubber gloves and blankets, protective screens and barriers, danger signs, etc., to adequately protect and warn all personnel in the vicinity of the tests.

D. Test equipment, material, and labor for electrical system testing execution. Test shall be by the outside testing agency engaged for this purpose.

PART 3. EXECUTION

3.01 GENERAL

A. All testing to be performed in compliance with NETA Acceptance Testing Specifications. All submitted test results must include statement indicating compliance.

B. Prior to start of field testing the installation shall be completed, punch listed and inspected by the Engineer and/or Owner’s Representative for satisfactory completion of work.

C. Testing may be witnessed by the Engineer or Owner’s Representative. Provide 1 week advanced notice accordingly.

D. Where hard copy reports are generated, provide all original reports bound in a three (3) ring binder and assembled in a professional format. All reports shall be submitted to Engineer for review. Upon approval, any hard copies shall be left on site or turned over to Owner’s Representative.

3.02 TESTING

A. Molded Case Breaker Tests: The tests shall include the following:

1. Check adjustable magnetic trip settings against nominal values.
2. Megger each pole for freedom from grounds.
3. Check connections and tighten as required.

B. Tests on Motor Starters and Contactors: Tests shall include the following:

1. Check equipment grounding to assure continuity of connections.
2. Remove any blocking used for shipment.
3. Check overload relays for proper current range with motor nameplate full load amperes. Adjust relays for manual or automatic reset.
4. Check each magnet coil for proper operating voltage.
5. Check auxiliary contacts for correct arrangement with coil de-energized; i.e.; normally open or normally closed.
6. Megger each pole of the starter or contractor for freedom from grounds.
7. Check fuses and/or circuit breakers for proper ratings as prescribed by the manufacturer for the actual motor supplied.
8. Check overload heater relays or other overload protection for proper ratings as prescribed by the manufacturer.
9. Check wiring connections and tighten as required
10. Check secondary fuses for proper ratings for motor starter control power transformers.

C. Inspection of Disconnect Switches:

1. Inspect contacts, clean as required.
2. Inspect arc chutes.
3. Inspect fuses for proper rating, type, and size.

D. Lighting System Tests:

1. Test lighting systems for proper operation, for conformance with indicated switch control on the Drawings, for dimming, etc.
2. Set time clocks with astronomical dials to turn "ON" at sunset and "OFF" at sunrise and test operation.

E. 600-Volt Wire and Cable Tests:

1. 600-volt wire shall be meggered with a 500-volt megger for one minute, and values must be approximately as listed as follows:

Conductor Capacity	Resistance
Amperes	Ohms
0 - 24	1,000,000
25 - 50	250,000
51 - 100	100,000
101 - 200	50,000
201 - 400	25,000
501 - 800	12,000
Over - 800	5,000

2. The above values shall be determined with switchboards, panel boards, fuse holders, switches, and over current devices in place. Devices containing semi-conductors, such as diodes, transistors, and other devices, which can be damaged by the megger shall not be connected during meggering. Motors and transformers shall not be connected during meggering. Wire and cable shall be meggered after installation, not on the reel.

3. Wiring to be meggered shall be limited to feeder wiring between main distribution equipment and power panels, branch circuit panels, motor control centers, individual pieces of mechanical equipment and other similar equipment. Wiring for mechanical equipment connected to branch circuit panels shall also be meggered. Branch circuit wiring for lighting and receptacles shall not be meggered.

4. The Contractor shall perform all phasing tests and shall make changes necessary to assure proper rotation of all motors, the correct phasing and phase sequence of all circuits susceptible of being paralleled, the proper polarity on all instrument transformer wiring, and such other phasing tests and changes as may be required for the equipment being connected under this Contract.

F. Panelboards:

1. Test breaker ON/OFF operation.

2. Test voltages between phase and phase to ground at:

   a. Before incoming breaker.
   b. After the incoming breaker at the bus.
   c. At all feeder breaking.

3. Record all test results.

G. Miscellaneous Equipment Tests: Test all miscellaneous equipment for proper operation in accordance with equipment manufacturer's instructions.

3.03 SYSTEM STARTUP

A. Testing and Startup:

1. All elements of each electrical control system shall be confirmed to demonstrate that the total system satisfies all of the requirements of this Specification. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner and Systems Integration Engineer.

2. Factory Tests: The electrical controls and all other associated hardware shall be tested via a full simulation at the factory, prior to shipment, to demonstrate that each component is operational and meets the requirements of these specifications. Manufacturer shall provide test routine program for shop testing of I/O wiring. Test results shall be certified, with written documentation provided to the Engineer upon test completion. Factory testing may be witnessed by the Engineer.

3. Field Tests: All electrical control system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly. Witnessed field tests shall be performed on the complete system. Contractor shall provide a checklist for all electrical, control and instrumentation functions and send to Engineer for approval. Each function shall be demonstrated to the satisfaction of the Owner and Engineer on a item-by-item basis. Each test shall be witnessed and signed off by the Contractor and the Engineer upon satisfactory completion. The Contractor shall notify the Owner at least 2 weeks prior to the commencement date of the field tests. After tests are completed and with system fully operational, system shall run continuously for a period of 10 days without failure. Any failures shall be repaired and 10 day test shall start over again.

4. Start-up Testing will require a minimum of 10 working days after work is substantially complete, including loading of programs to local PLC. Provide 4 weeks' notice for program downloading by Programmer. This shall be accounted for in project schedule.

5. Prior to testing system, any PLC programs or HMI programs provided by other than the Systems Integration Engineer shall be furnished on CD for review by Engineer. Provide any special software necessary to run and test complete program.

END OF SECTION

Section 16020

Electrical Selective Demolition

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. This section covers selective demolition of electrical equipment.

1.02 REFERENCES

A. Temporary wiring of systems to maintain operation of facilities while undergoing modifications and demolition shall be provided in accordance with:

1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC), Article No. 590 - Temporary Installations.

1.03 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

B. Submit all products covered under this section for Engineer's approval.

C. Annotate existing drawings to sequence the demolition of systems, equipment removal, and temporary hook-ups.

D. Schedule with Owner for required shutdowns to accommodate system demolition and installation of temporary facilities.

E. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 QUALITY ASSURANCE

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents. Report any discrepancies to Engineer before disturbing existing installation.

D. By beginning demolition, installer accepts existing conditions and warrants that he will maintain service to equipment and items not scheduled or indicated for

removal, and that he will return to the Owner all serviceable items and systems in good operating conditions.

E. Before starting demolition, test installation and verify operating condition of all equipment that is to remain serviceable. Notify Owner in writing of any equipment that is not operable.

PART 2. PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections, or as required to complete work intended by plans and specification.

B. The temporary electrical wiring and facilities shall be designed and constructed in strict compliance with NEC - Article No. 590.

PART 3. EXECUTION

3.01 PREPERATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal as shown on plans.

B. Coordinate utility service outages with Utility Company to provide continuous service to operating equipment.

C. Where required, provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the Owner at least one week before partially or completely disabling system. Minimize outage duration.

E. All existing equipment that is to remain serviceable shall be covered and sealed to prevent dust or water intrusion.

F. Where equipment, motor control centers, panels, and devices are to be removed or relocated and where wiring is to remain or be reused, trace out all wiring and tag conductors. Record data in “As-Built” drawings.

G. Where equipment is to be reused and is disabled without power for a period of over 1 week, the equipment shall be stored in a dry location and a heater shall be installed inside the enclosure and remain activated until equipment is placed back in service.

3.02 DEMOLITION

A. Demolish and extend existing electrical work as shown on plans, and as understood from observable conditions noted during the pre-bid site visit.

B. Remove, relocate, and extend existing installations to accommodate new construction. This includes rerouting of underground duct banks and conduits that may not be documented on Owner's record drawings. Contractor is to allow for these conditions in bid price. Failure to do so is at Contractor's risk.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, plug conduit, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment servicing utilization equipment that has been removed.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing installations, which remain active. Modify installation or provide access panel as appropriate.

J. Extend existing installations using materials and methods as specified for new work.

K. Any existing equipment that is to remain serviceable and is damaged during demolition or during new work shall be repaired or replaced to Owner's satisfaction in working condition.

3.03 DISPOSAL AND SALVAGE

A. Salvage electrical and instrumentation equipment removed from existing facilities for reuse as shown on plans.

B. Material and equipment, which can be reused or salvaged, remains the property of the Owner unless specifically indicated in the Specifications or Drawings, or as designed by the Owner.

C. Materials and equipment which cannot be reused or salvaged for Owner's use will be removed and disposed by the Contractor at approved disposal facility.

D. Remove, seal, and store generators, motors, and other large equipment for Owner's use. Store at designated location wrapped in water and dust tight covering and on skids.

3.04 CLEANING

A. Clean and repair existing materials and equipment, which remains or is to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangements.

END OF SECTION

Section 16050

Basic Electrical Materials and Methods

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. The electrical drawings and specifications under this section shall be made a part of the full contract documents. The drawings and technical specifications of this contract, supplemental information issued thereto, information to bidders and pertinent documents issued by the owner's representative are part of the overall construction documents. All constructions documents shall be complied with by general contractor

D. The requirements herein are base requirements for all specifications. Other specifications will refer to this section for detailed requirements. No one specification will have all details. Specifications shall be reviewed as a complete package. Coordinate as needed

E. All the above documents will be on file at the office of the owner's representative and shall be examined by all bidders prior to bid. Failure to examine all construction documents shall not relieve the responsibility of a fully functional system as described

F. The documents shall not be used as a basis for additional compensation due to omission of details of other sections, specifications, documents, and drawings

G. Furnish all work, labor, tools, staff, material, equipment, and operations necessary to provide and install a complete and functioning electrical system as defined in construction documents

H. The contractor shall be responsible for visiting the project site prior to bid submission to verify existing conditions for relevant modifications to final bid

I. It is the intent of the contract document that upon completion of the scope of work, the entire system shall be a finished/workable condition

J. Secure all permits, licenses, easements, and inspections as required by all authorities having jurisdiction. Give all notices and comply with laws, ordinances, rules, regulations, and contract requirements

K. Contractor shall determine the exact requirements for the utility service connections and metering facilities as set forth by the utilities that will serve the project. Contractor shall pay for and perform all work as required by those utilities. Refer to section 1.02 (A) for allowance requirements

L. This specification section is an inherent part of all work performed on this project and its contents shall apply for any and all electrical, controls, instrumentation, communication, and security related work

M. This specification covers all electrical equipment materials and methods required for a fully functional electrical system. This specification holds as a foundational document for electrical items stated in specifications under the same division

N. Relocations and adjustments up to 50 feet are required per this contract as requested by owner or engineer at no additional cost to owner. Include cost in bid

O. Contractor shall provide the equipment necessary for locating all underground pipes, conduits, and structures before digging. All locations of intersection shall be properly staked and identified. Locating all underground utilities is the sole responsibility of the contractor at no additional cost to owner

P. Where obstructions are present in existing spare underground conduits to be used in this project, use video camera to determine cause of obstruction. Coordinate with engineer

Q. Provide arc flash warning tags on all electrical equipment where required by NFPA 70E. Submit arc flash analysis for engineer's review

R. Major scope of work:

1. Provide and install lighting system as described in construction drawings and technical specifications
2. Provide and install fully operational SCADA control panel operating capable of reading EST data and issuing alarms to operators. Control panel shall contain built in overcurrent protection system for electrical service and per pump, surge protection system, and emergency power quick connection transfer system with overcurrent protection
3. Provide grounding system per NEC Article 250, construction drawings, and technical specifications
4. Provide and install underground and above ground conduit/ductbank system as described in construction drawings and technical specifications

S. High level system requirements:

1. The electrical and control system shall include, but shall not be limited to, all circuit breakers, motor starters, alternator, contactors, indicating lights, selector switches, surge protector, phase failure, heaters, instruments, relays, programmable controllers, alarm light, push buttons, control transformers, electronic devices, sensors, interlock wiring, nameplates, and all other associated items required
2. Provide all heaters and equipment to motors per associated references and manufacturer's instructions

1.02 REFERENCES

A. Installations shall conform to all appropriate articles/sections of latest standards, codes, local codes, and ordinances of the owner, authority having jurisdiction, and all entities involved. Contractor shall be responsible for verifying relevance of each reference requirement per the project scope, appropriateness, owner input, and historical requirements. Contractor may submit questions on code requirements where legitimate conflict exists. Relevant references may include all shown below:

1. National Electrical Code (NEC)
2. Underwriters Laboratories (UL)
3. National Electrical Manufacturers Association (NEMA)
4. Insulated Power Cable Engineers Association (ICEA)
5. International Building Code (IBC)
6. National Fire Protection Association (NFPA) 70E – "Standards for safety in the workplace"
7. American National Standard Institute (ANSI)
8. Institute of Electrical and Electronic Engineers (IEEE)
9. International Energy Conservation Code (IECC)
10. Texas Center for Environmental Quality (TCEQ)

B. Where contract documents indicate requirements, which are in excess of minimum requirements stated in section 1.03 (A), the most stringent requirements shall be met. Should there be any conflicts between the contract documents and section 1.03 (A), submit RFI's prior to bid

C. Codes and ordinances having jurisdiction and specified codes shall serve as minimum requirements. Where the Contract Documents indicate requirements which are in excess of those minimum requirements then the requirements of the Contract Documents shall be followed. Should there be any conflicts between the Contract Documents and codes, or any ordinances, report these with bid

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Contractor is bound to coordinate all equipment and scope of work with engineers and sub-contractors under this contract. Coordination of various equipment installations and operations is required as not to delay scheduled installation and startup
2. Refer to contractor responsibilities section of this document for further coordination items

B. Preinstallation meetings

1. Should contractor require a pre-installation meeting for any equipment with engineer, contractor shall provide ample time to schedule all required parties

C. Scheduling

1. Provide schedule of construction to engineer for review on a monthly basis. Refer to submittal section for further requirements

D. Change orders

1. Change orders and RFI's shall be submitted with full technical explanation of request and shall contain statement confirming contractor has reviewed all construction documents
2. Confirm all work has been coordinated with all other trades prior to submitting change order

1.04 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.05 RECORD DRAWINGS

A. At the start and during the progress of the job, keep one separate set of blue-line prints for making construction notes and mark-ups

B. Show conduit routing and wiring runs as constructed and identify each

C. Record all deviations from the contract documents

D. Submit set of marked-up drawings for review

1.06 QUALITY ASSURANCE

A. All manufacturers named are a basis of design for standard and quality expected. Substitutions of any equal product will be considered for acceptance. The judgement of equality of product substitution shall be made by the engineer and owner

B. UL Compliance: Materials manufactured within scope of Underwriters Laboratories shall conform to UL standards and have an applied UL listed mark

C. Materials and equipment shall be new, free from defects. Any and all equipment deemed defective by engineer shall be replaced at no additional cost to owner

D. All materials and equipment, of the same class, shall be supplied by the same manufacturer unless specified otherwise in construction documents

E. Contractor shall consider all degrees of uncertainty for all existing, hidden or unknown conditions. Bid shall cover all reasonable unknown conditions not evident in pre-bid site visit for additions and modifications to existing facilities

F. Any change orders or additional work beyond the scope of this project as bid shall be approved by engineer. Any unapproved work performed is at contractors' risk

G. Installation shall conform to engineering drawings and described in specifications. Any variation shall be pre-approved in writing by engineer before work begins. Any unauthorized work may be requested for removal at contractors' expense with no delay to construction schedule and at no additional cost to owner

H. Prior to bidding and during construction, contractor shall coordinate with equipment vendors/suppliers and determine requirements for power, control, and interconnection wiring. Provide conduits and conductors accordingly for complete operating system

1.07 PROJECT SAFETY:

A. Electrical system for this project has lethal voltages present. Contractor shall have qualified personnel perform installations by, or under direct on-site supervision of, a licensed master electrician

B. Contractor shall not work on energized equipment except when necessary and with all appropriate protective clothing, tools, and qualified staff required to perform tasks

C. Submit "Job Safety Plan & Electrical Work Permit" per NFPA 70E to engineer

D. Do not install fuel tanks within 50-feet of habitable building where prohibited by local codes. Field verify site with construction documents and notify engineer of any conflicts. Failure to do so is at contractors

1.08 CONTRACTOR QUALIFICATIONS

A. All prequalification's under this contract shall be submitted prior to bid date

B. All electrical work shall be performed by a Texas State Licensed Electrical Contractor

C. Contractor and their subcontractors shall be experienced with electrical systems covered under this contract

D. Contractor firm, project supervisors, and electrical labor workers without recent experience in similar projects shall not be utilized to perform work under this contract. Projects older than 5-years are not considered recent

E. Electrical contractors, electricians, inspectors, installers, and programmers assigned to this project shall be full-time qualified employees

F. Contract employees shall not be utilized unless approved by engineer

G. Contractor shall be required to furnish proof of experience and employment where requested by owner, engineer, or their representatives

H. Maintain safety training program throughout project timeline. Program may be requested for review by owner, engineer, or their representatives

I. Pre-qualified electrical contractors are shown below:

1. Alterman
2. Big State Electric
3. CC Electric BCS
4. Clarion Electrical, LLC
5. McDonald Electric
6. Pfeiffer & Son, Ltd.
7. RESCO Electric
8. SECO
9. W.W. Payton
10. Or as pre-approved in writing via email, not less than seven (7) days before bid date

1.09 CONTRACTOR RESPONSIBILITIES

A. Contractor is bound to coordinate all equipment and scope of work with engineers and sub consultants under this contract. Coordination of various equipment installations and operations is required as not to delay scheduled installation and startup

B. Any and all delegation of construction of sub-contractors shall be coordinated prior submittal review and meetings with owner, owners' representatives, and engineering team

C. Scope of work in each specification and discipline drawings are ultimately the sole responsibility of the general contractor under this contract

D. Contractor shall verify all product materials and drawings prior to bidding

E. Plans and diagrams are illustrative and may not contain all devices, wiring point-to-point diagrams, and controls required to perform the intended function in construction documents. Not all required equipment quantities required for a fully functional system may be documented in drawings or specifications. Location and alignments for equipment shown on plans may require adjustment. Contractor is responsible for providing all appurtenances required for each stand-alone system and overall project system

F. Vendor furnished systems shall be coordinated prior to submittal to meet all required expectations in construction documents. All additional fees for testing, commissioning, and warranties shall be included in bid for all equipment/installation

G. Contractor to provide full contact list of all sub-contractors and vendors under this contract to engineer upon notice to proceed. Contact information shall include: Person's name, title, direct telephone number, address, and email information

H. All correspondence, RFI's, and submittals concerning electrical, controls, and related work shall be from general contractor. General contractor shall provide statement on all correspondence, RFI's, and submittals stating contractor has verified information and validity of the correspondence in reference to full construction documents from all disciplines. Any documents received not having this statement may be rejected without review

I. Contractor shall reach out to engineer for coordination of construction methods, plans, and specifications should they deem beneficial

J. Coordinate and pay all electrical power, natural gas, hardline telephone, cellular telephone, or special purpose utility installation. Contractor shall coordinate with owner for account setup or transfer ownership at substantial completion, method of choice is contractor's responsibility

K. Maintain documentation and notify owner of all utility coordination and requirements for new/modified services

1.10 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components including:

1. Electrical wiring
2. Supporting structures
3. Building materials
4. Metal bodies requiring bonding to lightning protection components
5. Building finishes

B. Coordinate installation of air terminals attached to single-membrane roof system with roofing manufacturer and installer

1.11 SPARE PARTS

A. Spare parts shall be hand delivered to operations team at 75% completion of project completion to operations team

B. Furnish, tag, and box all spare parts in an organized manner. Provide detailed bill of materials of all items included in box

C. Provide transmittal form documenting individuals delivering and receiving spare parts with date, signature, printed name, and title. Provide scanned copy to engineer for record keeping. Include documents in O&M manual

D. Provide the following spare parts:

1. Fuses (0 – 600V): Six of each type and each current rating installed as part of this project unless otherwise specified

1.12 EMERGENCY POWER

A. Where required by drawings, provide any and all provisions for continuous electrical service thru contractor furnished standby generator power. Contractor shall not utilize an existing standby generator on the facility unless given permission by owner and engineer. Include all provisions in bid

B. Where power outage is required, coordinate with owner and engineer. Outage length shall be coordinated and approved by owner and engineer. Where outage exceeds approved timeframe, contractor shall provide equipment as required to maintain electrical power

PART 2. PRODUCTS

2.01 GENERAL

A. Products shown are not intended to discriminate against a product of similar quality and purpose by another manufacturer

B. Provide coordination with manufacturer's representative for exact model, options, configurations, and services included in bid. Where construction documents do not match manufacturer's representative equipment list, contact engineer prior to ordering and installing

C. Substitution items may be acceptable where deemed so by engineer and or owner's representative

D. All equipment and materials shall be rated for harsh industrial environments.

E. Equipment ratings shown on construction documents are minimum requirements and contractor may be required to provider the next size greater

F. Door mounted rotating operating mechanisms for circuit breakers are not permitted

G. All equipment installed on this project shall incorporate the installation of all devices and features to protect their respective equipment from the influence of other equipment, voltage irregularities, phase irregularities, power surges, harmonics, and other disturbances that may prevent proper and safe operation

H. All equipment shall be NEMA rated, IEC components are prohibited

I. Where model numbers are shown on drawings or specifications, provide current most up to date available model

PART 3. EXECUTION

3.01 GENERAL

A. Where required by drawings, provide any and all provisions for continuous electrical service thru contractor furnished standby generator power. Contractor

shall not utilize an existing standby generator on the facility unless given permission by owner and engineer. Include all provisions in bid

B. Where power outage is required, coordinate with owner and engineer. Outage length shall be coordinated and approved by owner and engineer. Where outage exceeds approved timeframe, contractor shall provide equipment as required to maintain electrical power

C. All construction and equipment fabrication shall be of highest quality and installed in a workmanlike manner

3.02 TESTING

A. All equipment shall put through a trial run-in test to ascertain the performance complies with the intent of the specifications. All-in tests shall be made in the presence of the Engineer and owner's representatives. Control system shall be setup, calibrated, and tested by manufacturer's technician.

B. Contractor shall startup entire system prior to engineer present inspections. All troubleshooting and issues shall be corrected prior to scheduling owner/engineer inspections

C. All special testing of materials and equipment shall be provided by the contractor

D. Contractor shall coordinate and schedule testing and startup work with the owner and engineer

E. Provide full documentation for factor test and field tests

F. Where facility is located more than 100 miles from the project site, supplier shall provide accommodations for overnight stay for engineering team

G. All cables shall have an insulation test performed using 1000-volt megger that has been calibrated within the last twelve months

H. Cables installed with an insulation reading less than 500 megohms shall be removed and new cable installed and retested at no additional cost to the owner.

I. Cables installed with an unacceptable insulation reading shall be removed and new cable installed and retested at no additional cost to the owner. Submit cable megger test report to owner's representative and engineer for review. Include test results in O&M's.

J. The grounding system shall be tested in the presence of the owner's representative using the fall of potential method and shall provide a grounding system resulting in an ohmic value of five (5) ohms or less at no additional cost to the owner. The contractor shall submit test report to owner's representative. Test equipment must be calibrated within the previous 12 months. Provide dated calibration results along with submittal.

K. All controls shall be fully tested prior to shipment and installation at project facility

L. Contractor shall fully inspect all controls, wiring devices, conduit, and other items before starting work, ordering materials, or submitting shop drawings for

discrepancies to construction documents. Inform engineer of any discrepancies. Failure to do so may result in contractor's responsibility for any required changes at no additional cost to owner

3.03 TRAINING

A. Contractor shall provide two (2) 8-hour classes covering all equipment installed from a systematic level to general maintenance, operation, and troubleshooting. Provide all training manuals prior to start of class to operations, owner, and engineer for review

B. Engineer or owner may attend training where requested

C. Contractor shall provide adequate classroom environment or coordinate for on site facility to cover training

D. Training agenda and outline of training course shall be forwarded to engineer for review

E. Coordinate with any and all manufacturers required for adequate training

F. Document all attendees and acquire signatures upon completion of training program

G. Owner/Engineer shall sign a document provided by contractor indicating installation has formally been accepted

H. Inform engineer where training does not require two (2) full 8-hour classes

I. Schedule with owner minimum two (2) weeks in advance

3.04 INSTALLATION

A. All slabs around electrical equipment shall be constructed and sloped to avoid any standing water

B. Do not overfill raceways. Provide additional conduit where cables purchased exceed standard cable fill calculations

C. Provide minimum 48 inches of workspace in front of electrical equipment

D. Provide a minimum of 8 inches between wall or rack mounted enclosures/ equipment. Do not extend past building wall and maintain 6 inches from edge of wall

3.05 REPAIR/RESTORATION

A. Where any equipment performance does not conform to specifications or parameters are out of tolerance, per engineers or owner's opinion, contractor shall remove and replace equipment at no additional cost to owner

B. Where contractor damages existing facilities, damaged equipment shall be replaced with equal or better at no additional cost to owner. Contractor shall take photos of

facility prior to starting work to dispute any discrepancies. Where photos are not taken, damaged equipment shall be replaced at owner's request

C. Any damage to underground utilities is the responsibility of the contractor for repair and restoration

D. Where equipment fails or gets damaged, contractor shall replace with new. Repair is not permitted unless specifically approved by owner, owner's representative, or engineer

3.06 SYSTEM STARTUP

A. Upon successful testing, contractor shall provide full system startup in presence of authority, owner's representative, and engineer presenting fully functional gate operating system with all respective capabilities.

B. Contractor is responsible for coordinating with all parties required for system startup including manufacturer's prior to system startup. Ample time is required for coordination.

C. System will be not be accepted by owner until all systems are started and presented to authority, owner's representative, and engineer without issues or pending punch list items.

3.07 ADJUSTEMENT/CALIBRATION

A. Should initial testing or system startup not present an acceptable functioning system, adjustment/calibration shall be performed as necessary at no additional cost to owner.

B. All equipment shall put through a trial run-in test to ascertain the performance complies with the intent of the specifications. All-in tests shall be made in the presence of the Engineer and owner's representative.

3.08 CLEANING

A. Remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work, clean equipment and entire installation site in a workmanlike manner. No loose parts or scraps or equipment shall be left on the premises. Site shall not be accepted by owner where site is not suitably cleaned to engineer or owner's representative preference.

B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer, or with an approved paint.

C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt, and debris.

D. Concrete spoils shall not be dumped on site without approval by engineer or owner

3.09 CLOSEOUT

A. System acceptance upon substantial completion shall occur only when the below items have been submitted, accepted, and approved.

1. Submittals
2. O&M Manuals
3. Contractor testing
4. Inspections
5. Operations team training
6. Warranty certificates
7. Shop testing
8. Record drawings
9. Spare parts

3.10 MAINTENANCE/WARRANTY

A. Provide extended warranty certificates with contact information to operations and include in Operations & Maintenance manual.

B. Contractor shall provide full system wide warranty on all equipment for 3-year. Warranty shall include all labor and materials required to repair or replace equipment defective or malfunctioning at no additional cost to owner

C. Provide any and all testing equipment required to verify equipment malfunction (i.e. power monitor, etc.)

D. Warranty shall include, but not limited to; equipment, devices, hardware, and software

E. Warranty begins at time of written acceptance of substantial completion

F. Provide warranty certificates for electrical installation and consolidate warranty certificates from sub consultants with contact information for repairs

G. General contractor is ultimately responsible for all warranty items and requests

H. All repairs shall be made within 24 hours of receipt of required parts from manufacturer with minimum priority shipping. Any repairs not completed within five (5) working days from date of notice are subject to owner hiring separate integrator to perform services. Services shall be invoiced to general contractor

END OF SECTION

Section 16051

Basic Electrical Submittal and O&M Requirements

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Requirements described in this specification are in addition to any submittal requirements of other specifications

1.02 SUBMITTALS

A. Submit all submittals within sixty (60) days of notice to proceed.

B. Review of submittals shall not remove sole responsibility of contractor for furnishing materials or equipment of proper dimension, quantity, quality, or rating; nor will such review remove the responsibility for errors in the submittals.

C. Each submittal shall be submitted as a single pdf per specification with all related equipment.

D. Include catalog cuts, general descriptive information, catalog numbers, and manufactures name

E. Shop drawings shall include detailed drawings with dimensions, schedules, weights, capacities, installation details, and all pertinent information for a complete and fully functional equipment installation.

F. Failure to process submittals on any item(s) specified shall be at risk of contractor to replace any and all unreviewed items as directed by engineer, authority, or owner.

G. Contractor shall assume all costs and liabilities which may result ordering and installing any equipment/material prior to review of the submittals. No work shall be done prior to review of all submittals. In case of corrections required, rejection and resubmit required; resubmit submittals until owner's representative and or engineer review updated submittals. This process shall not label as cause of any delays in construction.

H. Contractor shall have two (2) submittal reviews after which contract may be charged by owner and or engineer at firm hourly rates to review additional submittals. After final reviews, provide final copies in printed/PDF O&M Manuals.

I. Submittals shall be compiled from the manufacturer's latest product data. Provide most update product where product specified has been replaced, recalled, discontinued, or newer product exists. Provide description on submittal stating reason for not providing product specified in construction documents.

J. Contractor shall clearly indicate on submittal which items and options are proposed. Submittal may be marked rejected-resubmit where if specific items and options proposed are not clearly marked. Submittal may be rejected where transmittal cover page and required information in this section is not provided.

K. Where requested, furnish samples of materials for acceptance review. If a sample has been reviewed and accepted, equipment installed shall maintain equal quality to sample provided. Should engineer deem installed equipment does not match quality of sample provided, item shall be replaced at engineer's discretion at no additional cost to owner

L. Submittals shall be provided one section at a time. All related submittals are to be provided at one time

M. Hard copies are not required for submittal review. Where required by owner, or general conditions, hard copies of any and all documentation shall be under the contractor's responsibilities

N. Provide a schedule describing estimated start dates, completion dates, shop test dates, and field test dates. Contractor shall provide updated schedules to our office in a regular schedule upon any changes

O. Contractor shall provide submittal log showing status of submittal approved, rejected, and pending with each submittal

P. Contractor shall review all voltages, horsepower, current, phase, and starter size requirements for all equipment prior to providing submittals to engineer for review. Shop drawing review by engineer does not remove this responsibility. Incorrect submittal information shall be at risk of contractor and at no additional cost to owner

Q. Data sheets shall have model numbers that correctly identify equipment and accessories as described in construction documents highlighted or boxed

R. Submittals shall require a minimum of two (2) weeks for review from time of receipt by engineer. Contractor shall provide submittals with sufficient time for review as to no impede construction schedule. Lack of required coordination shall not be acceptable for construction schedule extension

S. All submittals for control panels, control sections of MCC, controllers, and vendor furnished panels shall contain statement of U.L. certification and identifying name and number of U.L. certification for fabrication shop. All submittals without this information shall be marked rejected. Any panels installed without U.L. listing, and where not acceptable by engineer or owner, shall be replaced at no additional cost to owner

T. Any and all equipment installed without approval not matching construction documents shall be replaced at no additional cost to owner

U. General contractor shall route all vendor submittals with electrical requirements to electrical contractor who shall review and coordinate all power and control items. Any variation to construction documents shall be noted accordingly on submittal

V. All resubmittals shall indicate modifications due to original submittal comments from engineer

W. Include all relevant technical specifications with each submittal. Mark each section as “comply”, “non-compliant”, and “substitution”

X. Provide transmittal cover page on all submittals with the following information:

1. General contractor company name
2. General contractor project manager name and contact information
3. Sub-contractor company name
4. Sub-contractor project manager name and contact information

1.03 ACCEPTANCE AND SUBSTITUTIONS

A. All manufacturers named are a basis as a standard of quality and substitutions of any equal product will be considered for acceptance. The judgment of equality of product substitution shall be made by the Engineer and owner’s representative

B. Substitutions for equipment specified or shown on plans as “Or pre-approved equal” shall be submitted for approval prior to bid. Failure to submit RFI for pre-approval may lead to rejection of substitution for higher cost equipment originally specified in construction documents.

C. Substitutions after award of contract shall be made only within sixty (60) days after notice to proceed. Furnish all required supporting data. The submittal of substitutions for review shall not be cause for time delay of construction.

D. Where substitutions are offered, the substituted product shall meet the product performance as set forth in the specified manufacturer’s current catalog literature, as well as meeting the details of the construction documents.

E. The details on the drawings and the requirements of the specifications are based on the first listed item of material or equipment; if any other than the first listed materials or equipment is furnished, then assume responsibility for the correct function, operation, and accommodation of the substituted item. In the event of misfits or changes in work required, either in this Section or other Sections of the Contract, or in both; bear all costs in connection with all changes arising out of the use of other than the first listed item specified

1.04 REQUIRED SUBMITTALS FOR REVIEW:

1. Wiring devices
2. Wire
3. Conduit and fittings
4. SCADA system
5. Main service disconnect/circuit breaker
6. Enclosed circuit breakers

7. Mini-power zones
8. Surge protection devices
9. All relays & terminals
10. Grounding
11. Junction boxes and pull boxes
12. Terminal junction boxes
13. Panelboards and circuit breaker data
14. Fuses
15. Contactors
16. Transformers
17. Lighting fixtures and poles
18. Control cabinet enclosures
19. Control cabinet wiring and terminal blocks
20. Control cabinet devices and nameplates
21. Control panels
22. Vendor furnished equipment
23. Project schedule on a monthly basis
24. Warranty certificates
25. Testing reports

1.05 OPERATIONS & MAINTENANCE MANUALS

A. Hardcopies provided to owner, once approved, are to be professionally assembled with tabs and coversheets

1. Wiring diagrams shall be on same size pages (8.5 x 11 or 11 x 17 pullout sheets) as used in O&M's and shall be placed in a separate section of the manuals identified "Wiring Diagrams"

a. Each O&M manual hard copy shall include USB jump drive containing complete and organized in PDF format inserted in pocket of binder

b. All O&M manuals shall be written in a professional manner and bound in high quality latching vinyl binder. Loose page three ring binders shall not be used for hard copy O&M manual

B. Provide diagrams of all control panels in clear plastic laminated pages. One (1) hard copy and one (1) copy in pocket affixed to inside of cabinet door

C. Six (6) weeks prior to the completion of the project, compile an operations and maintenance manual for each item of equipment. These manuals shall include

detailed instructions and maintenance, warranty certificates, vendor contact information, and spare parts lists

D. O&M manuals shall be reviewed by engineer and owner's representative prior to printing and delivering hard copy to operations

E. In addition to record drawings, submittals, manufacturer's operational instructions, and maintenance instructions, O&M's shall include sufficient literature to detail operation, removal, installation, configuration, adjustment, calibration, and testing of equipment by operations

F. All related submittals are to be provided at one time as follows:

1. Contact information for all contractors and vendors
2. System hardware/installation
3. System software (where applicable)
4. Operation of equipment
5. Electrical and Control wiring diagrams
6. Maintenance and Troubleshooting
7. Warranty Certificates
8. Point-To-Point wiring diagrams for each circuit installed

G. O&M manuals should be complete and approved prior to any scheduled training

1.06 RECORD DRAWINGS

A. At the start and during the progress of the job, keep one separate set of blue line prints for making construction notes and mark-ups

B. Show conduit routing and wiring runs as constructed and identify each. Record all deviations from the Contract Documents

C. Submit set of marked up drawings for review

D. The Contractor is always required to keep up to date blue lines and may be reviewed during construction at any time by the Engineer. Record Drawings that are found to be inaccurate are the responsibility of the Contractor

E. Provide Record Drawing that clearly show any work that varies from the Contract Drawings. Remove any lines or text from drawings that no longer apply as a result of as installed variations. "Record Drawing" Drawings shall be on backgrounds that are furnished by the Engineer. Submit Record Drawing Drawings electronically for review

F. Show accurate dimensioned layout of conduits under or encased in building slabs

G. Show accurate dimensioned location of all conduits and ductbanks on site and on structures that are installed or modified under this contract. Identify conduits by tag number

H. Record Drawing construction drawings shall be provided on full size plan sheets for Owner and furnished electronically in AutoCAD format for Owner and Electrical Engineers files. Provide hard copy quantities specified in this specification or in General Conditions Specifications, whichever is more stringent

END OF SECTION

Section 16052

Electrical Identification

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. Identification of electrical materials, equipment, and installations

D. Nameplate identification on MCC's and control panels

E. Arc Flash Warning Signs

F. Equipment and High Voltage Warning Signs

G. Identification of conduit and conductors

1.02 REFERENCES

A. National Electrical Code: Components and installation shall comply with NFPA 70

B. Comply with ANSI C2

1.03 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.04 RECORD DRAWINGS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.05 OPERATIONS & MAINTENANCE MANUALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

PART 2. PRODUCTS

2.01 RACEWAY AND CABLE LABELS

A. Label wiring with yellow heat shrink type markers with black machine printing. Labels shall be Raychem or Panduit

B. Buried conduit marking tape for marking path of buried conduits shall be a six (6") inch and red color nominal width strip of polyethylene with highly visible and foil backed, repetitive marking "BURIED CONDUIT", or similar language, along its length

C. Nameplates shall be micarta lamicoid material, 1/8” thick, black background with white 3/8 IN. block lettering engraving. Attachment means shall be made with a minimum of two aluminum rivets. All instruments shall have round shaped black phenolic tags with white 1/4 IN. block lettering, attach with 316 SS cable

D. Manufacturer’s Standard Products: Where more than one type is listed for specified application, selection is Installer’s option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere

E. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size

1. Color: Black legend on orange field
2. Legend: Indicates voltage

F. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position

1. Provide identification wire marker for all power and control conductors.

G. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 in. wide for phase and ground conductor identification

H. Underground Line Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with following features:

1. Size: Not less than 6 in. wide by 4 mils thick.
2. Compounded for permanent direct burial service.
3. Embedded continuous metallic strip or core.
4. Printed Legend: Indicates type of underground line.

I. Tape Markers: Vinyl or vinyl cloth, self-adhesive, wraparound type with preprinted numbers and letters. Limited use for indoor control cabinets

J. Aluminum, Wraparound Marker Bands: Bands cut from 0.014 in. (0.4 mm) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors

K. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener

L. Aluminum Faced Card Stock Tags: Wear resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 in. (0.05 mm) thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application

M. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 in. by 0.05 in. for conduit and power conductor identification. Attached with stainless steel bands

2.02 ENGRAVED NAMEPLATES AND SIGNS

A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere

B. Engraving stock, melamine plastic laminate, 1/16 in. (1.6 mm) minimum thick for signs up to 20 sq. in. (129 sq. cm), 1/8 in. (3.2 mm) thick for larger sizes.

1. Engraved Legend: Black letters on white face.
2. Punched for mechanical fasteners or stainless-steel screws.
3. Use in control panels, MCC's, device housings, boxes, and similar locations.

C. Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4 in. (6.4 mm) grommets in corners for mounting

D. Exterior, Metal Backed, Butyrate Signs: Wear resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396 in. (1 mm), galvanized steel backing, with colors, legend, and size appropriate to application. 1/4 in. (6.4 mm) grommets in corners for mounting

E. Fasteners for Plastic Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless steel machine screws with nuts, flat washers and lock washers

F. Exterior, Painted Aluminum, Warning Signs: Wear resistant, non-fading, pre-printed aluminum with glossy finish with colors, and size appropriate to applications, ¼ inch grommets in corners for mounting. Provide per standards ANSI 2535 and OSHA 1910.145

2.03 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungusinert, self-extinguishing, 1 piece, self-locking, Type 6/6 nylon cable ties with following features:

1. Minimum Width: 3/16 inch
2. Tensile Strength: 50-pound minimum.
3. Temperature Range: -40°F to 185°F
4. Color: As indicated where used for color coding

B. Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer

2.04 MCC AND CONTROL PANELS

A. Wire Markers: Provide wire markers on all power and wiring in MCC's and panels of all types. Identify wire at points of termination at devices and at terminal strips

B. Provide nameplates on body or housing of all pressure switches, transmitters, and other devices

C. Provide engraved nameplates near base of all relays and similar devices. Adhesive materials not allowed

PART 3. EXECUTION

3.01 INSTALLATION

A. Disconnecting Means/Circuit Breakers

1. All disconnecting means shall include the identification of the circuit source that supplies the disconnecting means and be legibly marked, with durable label, to indicate its purpose.

B. Install identification devices according to manufacturer's written instructions.

C. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment

D. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project

E. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work

F. Self-Adhesive Identification Products: Not allowed. Use stainless steel screws.

G. Identify feeders over 600 V with "DANGER HIGH VOLTAGE"; in black letters 2 in. (51 mm) high, stenciled with paint at 10 ft (3 m) intervals over continuous, painted orange background. Identify following:

1. Entire floor area directly above conduits running beneath and within 12 in. (305 mm) of basement or ground floor that is in contact with earth or is framed above un-excavated space
2. Wall surfaces directly external to conduits concealed within wall
3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings
4. Entire surface of exposed conduits

H. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting
2. Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer
3. Apply one intermediate and one finish coat of silicone alkyd enamel

4. Apply primer and finish materials according to manufacturer's instructions

I. Identify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of systems listed below for identification

1. Bands: Pre-tensioned, snap around, colored plastic sleeves; colored adhesive tape; or combination of both. Make each color band 2 in. (51 mm) wide, completely encircling conduit, and place adjacent bands of 2 color markings in contact, side by side

2. Locate bands at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft (7.6 m) in congested areas

3. Colors: As follows:

a. Fire Alarm System: Red
b. Fire Suppression Supervisory and Control System: Red and yellow
c. Combined Fire Alarm and Security System: Red and blue
d. Security System: Blue and yellow
e. Mechanical and Electrical Supervisory System: Green and blue
f. Telecommunications System: Green and yellow

J. Install Caution Signs for Enclosures: Use label indicating system voltage in black, preprinted on orange field. Install on exterior of door or cover with stainless screws

K. Install Circuit Identification Labels on Boxes: Label externally as follows:

1. Exposed Boxes: Plastic label on cover

2. Concealed Boxes: Plasticized card stock tags

3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent

L. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 in. (150 to 200 mm) below finished grade. Where multiple lines installed in common trench or concrete envelope do not exceed an overall width of 16 in. (400 mm), use single line marker

1. Install line marker for underground wiring, both direct buried and in raceway

M. Color Code Conductors: Secondary service, feeder, and branch circuit conductors throughout secondary electrical system

1. Field applied; color coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG

a. Colored, pressure sensitive plastic tape in half lapped turns for distance of 6 in. (150 mm) from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible

unwinding. Use 1 in. (25 mm) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings

b. Colored cable ties applied in groups of three (3) ties of specified color to each wire at each terminal or splice point starting 3 in. (76 mm) from terminal and spaced 3 in. (76 mm) apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length

System Voltage	A	B	C	Neutral
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w	Brown	Purple	Yellow	Grey
Motor Control	1	Black		
	2	Red		
	3	Blue		
	Ground	Green		

N. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms

1. Legend: 1/4 in. (6.4 mm) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations
2. Fasten tags with nylon cable ties; fasten bands using integral ears

O. Conduit Identification: Use aluminum tags with SS bands at termination points such as MCC, light fixtures, control panels, receptacles and junction boxes. Tag is to include conduit tag and panel circuit number (where applicable.)

P. Apply identification to conductors as follows:

1. Conductors to Be Extended in Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit
3. Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, color coding, or cable marking tape

Q. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or

equipment operation. Install butyrate signs with metal backing for outdoor items

2. Install warning signs on the following equipment as a minimum requirement
   a. MCC Main Breaker
   b. Main Service Breaker
   c. Transfer Switch
   d. Where exposed bus bars inside.
   e. Automatic Power Factor Correction Units
   f. VFD's and Solid-state Starters
   g. Other locations described in No. 1 above.
3. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, and/or emergency operations

R. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal control, and alarm systems, unless units are specified with their own self-explanatory identification
2. Except as otherwise indicated, provide single line of text with ½ inch high lettering on 1 ½ inch high label; where two (2) lines of text are required, use ½ inch lettering on 2-inch-high label. For small control panels a smaller text may be used but shall be clearly readable. Use black lettering on white field. Use red lettering on white field where shown on plans or as requested by Engineer or Owner. Apply labels with stainless screws for each unit of following categories of equipment.
   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items
   c. Electrical switchgear and switchboards
   d. Electrical substations
   e. Motor control centers and control panels
   f. Motor starters
   g. Push button stations
   h. Power transfer equipment
   i. Contactors
   j. Remote controlled switches
   k. Dimmers
   l. Control devices
   m. Transformers
   n. Inverters

o. Rectifiers
p. Frequency converters
q. Battery racks
r. Power generating units
s. Telephone equipment
t. Conduits at manholes, at junction boxes, and pull boxes

3. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker
4. For control panels the nameplate designation shall be according to the control, alarm or status function indicated on the control diagrams, one-line diagrams, details as required in other applicable specifications for this project
5. Provide nameplate designations list and nameplate and text size for Engineer and/or Owner's approval as required by 1.02 of this specification

S. Labeling

1. In addition to requirements for labeling as specified throughout this section, install as follows:
   a. Phase color insulation is required for all conductors, no exceptions
   b. Apply numbered wire marking labels to control wires; power wiring in panelboards, pull and junction boxes, and at outlets to identify circuit numbers. Each control wire shall be labeled at each connection. Labels shall heat shrink type
   c. Apply Phenolic labels with engraved identification to wiring sets in each hand-hole to identify function. Use waterproof labels
   d. Apply write-on identification labels to empty conduits to identify each with information as to terminus of other end and also trade size of conduit.
   e. Install micarta nameplates with engraving to identify function and/or load served for the following:
      i. Panelboards
      ii. Overcurrent Devices
      iii. Power Quality Monitor
      iv. Control Panels
      v. Automatic Transfer Switch
      vi. Wet Well Junction Box
      vii. All components in control panel and SCADA panel

f. Micarta nameplates shall be attached with aluminum rivets, use two (2) per each nameplate

g. Submit for review a schedule for engraving along with size for each proposed micarta nameplate. Do not fabricate nameplate until review has been completed

h. Type circuit directory information on circuit directory cards on all panelboards and laminate

T. Wiring

1. Heat shrink type labels shall be installed to identify circuit numbers from panel boards. Install labels on each wire in each panelboard, junction, and pullbox, and device connection

2. Label each wiring run with heat shrink type labels inside each motor control center and in-service switchboard. Install write-on label ties around wire group at conduit entrance and write-on label the wire size, and service

3. Install numbered marking on each control wiring termination at each terminal strip and at each device. Do this in motor control center, terminal cabinets, safety switches, remote controllers, pilot operators, and instrumentation equipment. Number selected shall correspond to number on terminal strip

END OF SECTION

Section 16060

Grounding and Bonding

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only.

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. B3 - Standard Specification for Soft or Annealed Copper Wire
2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
3. B33 - Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
4. E699 - Standard Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components

B. National Fire Protection Association (NFPA): NFPA 780 – Standard for the Installation of Lightning Protection Systems

C. Underwriter’s Laboratories (UL): 467 UL Standard for Safety Grounding and Bonding Equipment

1.03 SUBMITTALS, RECORD DRAWINGS, AND O&M MANUALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

B. Test Results: Report of field tests and observations certified by contractor

PART 2. PRODUCTS

2.01 GROUDNING DEVICES

A. Exothermally welded joints shall be made with Enrico "cadweld"

B. Ground bus connectors shall be Square D type "LU", OZ Type "XLH", or equal

C. Products: Of types indicated and of sizes and ratings to comply with current NEC. Where types, sizes, ratings, and quantities indicated are in excess of current NEC requirements, more stringent requirements and greater size, rating, and quantity indications govern

D. Conductor Materials: Copper

2.02 WIRE AND CABLE CONDUCTORS

A. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding

B. Equipment Grounding Conductor: Green insulated

C. Grounding Electrode Conductor: Stranded cable

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B3
2. Assembly of Stranded Conductors: ASTM B8
3. Tinned Conductors: ASTM B33

2.03 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section

B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules

C. Bonding Strap Conductor/Connectors: Soft copper, 0.05-inch-thick and 2 inch wide, except as indicated

2.04 CONNECTOR PRODUCTS

A. General: Listed and labeled as grounding connectors for materials used.

B. Pressure Connectors: High conductivity plated units

C. Bolted Clamps: Heavy duty units listed for application

D. Exothermic Welded Connections: Provide in kit form and select for specific types, sizes, and combinations of conductors and other items to be connected

2.05 GROUNDING ELECTRODES

A. Ground Rods: Copper clad steel with high strength steel core and electrolytic grade copper outer sheath, molten welded to core

1. Size: 3/4 inch by 10 feet unless otherwise indicated.

B. Plate Electrodes: Copper plates, minimum 0.10 in. thick, size as indicated.

PART 3. EXECUTION

3.01 PREPERATION

A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated

1. Install separate insulated equipment grounding conductors with circuit conductors

a. Raceway may be used as equipment ground conductor where feasible in non-hazardous areas and permitted by current NEC for lighting circuits and receptacle circuits

b. Install insulated equipment ground conductor in nonmetallic raceways unless designated for telephone or data cables

B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicted

C. Signal and Communications: For telephone, alarm, instrumentation and communication systems, provide #4 AWG minimum green insulated copper conductor in raceway from grounding electrode system to each terminal cabinet or central equipment location

D. Ground separately derived systems required by NEC to be grounded in accordance with NEC Paragraph 25030.

E. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to grounding electrode as indicated in addition to separate equipment grounding conductor run with supply branch circuit

F. Connections to Lightning Protection System: Bond grounding conductors or grounding conductor conduits to lightning protection down conductors or grounding conductors in compliance with NFPA 780

G. Common Ground Bonding with Lightning Protection System:

1. Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode, using exothermic welded connection

2. Use bonding conductor sized same as system ground conductor and installed in conduit

H. At all water, wastewater and industrial facilities, install UFER grounding per Item 3.02 – “Installation” at all equipment structures and buildings unless specifically deleted

I. Bond all metallic fences, gates, posts, steel structural columns, and other exposed steel structures

J. Install ground rod at all outdoor control panel, service rack, equipment racks, radio tower, steel canopy structures, and other steel structures where electrical equipment is installed

3.02 INSTALLATION

A. Each item of equipment shall be adequately and thoroughly grounded. Comply with Article 250 of N.E.C., except where higher standards of grounding have been specified

B. Equipment grounding conductors (EGC) shall be installed where indicated. These wires shall be green colored for all sizes

C. EGC runs into equipment and shall be grounded to equipment bus where available, or to equipment ground lugs

D. Where grounding type myers hub are installed, bond EGC thereto and furthermore ground each myers hub lug to equipment ground bus or ground lug, or ground rod

E. In each motor terminal box, install equipment ground lug and connect EGC thereto

F. In each floodlight pole, install ground connector to pole and bond to conduit bushing and to EGC in branch circuit

G. Install grounding conductor in all raceways and ground at both ends

H. General: Ground electrical systems and equipment in accordance with current NEC requirements except where Drawings or Specifications exceed NEC requirements

I. Ground Rods:

1. Locate minimum of one rod length from each other and at least same distance from any other grounding electrode
2. Interconnect ground rods with bare conductors buried at least 24 in. below grade
3. Connect barecable ground conductors to ground rods by means of exothermic welds
4. Make connections without damaging copper coating or exposing steel
5. Use 3/4inch by 10ft. ground rods except as otherwise indicated.
6. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated

J. Metallic Water Service Pipe:

1. Provide insulated copper ground conductors, sized as indicated, in conduit from building main service equipment, or ground bus, to main metallic water service entrances to building
2. Connect ground conductors to street side of main metallic water service pipes by means of ground clamps
3. Bond ground conductor conduit to conductor at each end

K. Braided Type Bonding Jumpers: Use elsewhere for flexible bonding and grounding connections

L. Route grounding conductors along shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated

M. Test Wells: Locate as indicated, and fabricate in accordance with details indicated

N. UFER Ground:

1. Fabricate with 20 feet of bare 2/0 (minimum) copper conductor laid lengthwise in excavation for foundation or footings
2. Install so conductor is within 2 in. of bottom of concrete
3. Where base of foundation is less than 20 feet in length, coil excess conductor at base of foundation
4. Bond conductor to reinforcing steel at four locations, minimum. Bond to all electrical equipment
5. Extend conductor below grade and connect to building grounding grid or grounding electrode
6. Extend to all steel support columns for buildings, equipment structures or roof columns
7. Alternate UFER Grounding: Install 2/0 (minimum) bare copper conductor in 24” deep trench around perimeter of structures, buildings, slabs, and foundations where electrical or mechanical equipment is located. Install 4 ft. from edge of structure. Bond to all steel structure and equipment and to grounding system, using exothermic welded connections
8. Do not install ground grid conductors in or under existing concrete adjacent to generators electrical equipment without written approval from Engineer

3.03 CONNECTIONS

A. General: Make connections to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible

1. Use electroplated or hot tin coated materials to assure high conductivity and make contact points closer in order of galvanic series
2. Make connections with clean bare metal at points of contact
3. Aluminum to steel connections: stainless steel separators and mechanical clamps
4. Aluminum to galvanized steel connections: tinplated copper jumpers and mechanical clamps
5. Coat and seal connections involving dissimilar metals with inert material such as red paint to prevent future penetration of moisture to contact surfaces

B. Exothermic Welded Connections:

1. Use for connections to structural steel, water tanks, equipment, generators and enclosures, and for underground connections
2. Install at connections to ground rods and plate electrodes.
3. Comply with manufacturer's written recommendations. Use CAD-Weld or approved equal
4. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable

C. Terminations:

1. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure type grounding lugs
2. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to housing, terminate each conduit with grounding bushing
3. Connect grounding bushings with bare grounding conductor to ground bus in housing
4. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors

D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torqueing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A-486B

E. Connections at Test Wells: Refer to details for connections between conductors and ground rods

F. Compression Type Connections: Where compression type connections are specifically called for on plans, use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make visible indication that connector has been adequately compressed on ground conductor

G. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate entire area of connection and seal against moisture penetration of insulation and cable

3.04 OVERHEAD LINE GROUNDING

A. General: Comply with ANSI C2, "National Electrical Safety Code"; for "Single Grounded Systems"; using two electrodes in parallel if single electrode resistance to ground exceeds 25 ohms

B. Ground Rod Connections: Use exothermic welds for underground connections and connections to rods.

C. Lightning Arresters: Separate arrester grounds from other ground conductors.

D. Secondary Neutral and Tank of Transformer: Interconnect and connect to ground.

E. Grounding Conductor Protection: Protect grounding conductors running on surface of wood poles with molding of a type manufactured for this purpose. Extend from grade level up to and through communications and transformer spaces

3.05 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes:

1. Install 3/4inch by 10ft. driven ground rod in corner close to wall and set rod depth such that 4 inches will extend above finished floor
2. Where necessary, install ground rod before manhole is placed and provide No. 1/0 bare tinned copper conductor from ground rod into manhole through waterproof sleeve in manhole wall
3. Protect ground rods passing through concrete floor with double wrapping of pressure sensitive tape or heat shrunk insulating sleeve from 2 in. above to 6 in. below concrete
4. Seal floor opening with waterproof non-shrink grout.

B. Connections at Manholes:

1. Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to ground rod or ground conductor
2. Make connections with minimum No. 4 AWG stranded hard drawn copper wire
3. Train conductors' plumb or level around corners and fasten to manhole walls.
4. Connect to cable armor and cable shields by means of tinned terminals soldered to armor or shield, or as recommended by manufacturer of splicing and termination kits

C. Grounding System: Ground noncurrent carrying metallic items associated with manholes, substations, and pad mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

3.06 SITE QUALITY CONTROL

A. Test:

1. Subject completed grounding system to megger test at each location where maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells

2. Measure ground resistance without soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance
3. Perform tests by 2point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System"

B. Ground/resistance maximum values shall be as follows:

1. Equipment rated 500 kVA and less: 10 Ohms.
2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms.
3. Equipment rated over 1000 kVA: 3 Ohms.
4. Unfenced substations and pad mounted equipment: 5 Ohms.
5. Manhole grounds: 10 Ohms.

C. Deficiencies: Where ground resistances exceed specified values, notify Engineer, and if directed by Engineer, modify grounding system to reduce resistance values. Where measures are directed that exceed those indicated, provisions of Contract covering changes will apply

D. Report: Prepare test reports, certified by testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results

3.07 RESTORATION

A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated

B. Where sod has been removed, replace it as soon as possible after backfilling is completed

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition

D. Include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, or mulching

E. Restore disturbed paving as indicated

END OF SECTION

Section 16121

Low-voltage Conductors and Cables

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

1.02 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC):

1. Article 310 - Conductors for General Wiring
2. Article 200 – Use and Identification of Grounded Conductors

B. EPA, 40CFR, Part 261.24 Toxicity Characteristic

C. CSA FT-4 Vertical Cable Tray Flame Tests

D. Underwriter's Laboratories (UL)

1. UL 44: Rubber Insulated Wires and Cables
2. UL 83: Thermoplastic Insulated Wires and Cables
3. UL 514 B: UL Standard for Safety Conduit, Tubing, and Cable Fittings
4. UL 1063: Machine Tool Wires and Cables
5. UL 1277: Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
6. UL 1581: Reference Standard for Electrical Wires, Cables, and Flexible Cords

E. American Society for Testing and Materials (ASTM)

1. ASTM B3: Soft or Annealed Copper Wires
2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
3. ASTM B33: Tinned soft or annealed copper wire for electrical purposes

F. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations

G. IEEE 383: Vertical Wire Flame Test

H. IEEE 1202: Flame testing of cables for use in cable tray

I. Insulated Cable Engineers Association (ICEA)

1. ICEA S-61-402: Thermoplastic- Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC5)
2. ICEA S-66-524: Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-7)
3. ICEA S-68-516: Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8)
4. ICEA S-95-658 Non-shielded Power Cable Rated 2000 Volts or Less
5. ICEA T-29-520 Flame Test

1.03 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.04 RECORD DRAWINGS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.05 OPERATIONS & MAINTENANCE MANUALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.06 QUALITY ASSURANCE

A. Tests:

1. Cable shall meet all the requirements of Part 6 of ICEA S-61-402
2. Cable shall be tested at the factory to confirm that the cable complies with requirements of ICEA Section 7.7.9 of S-66-524 or 7.5.9 of S-68-516
3. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5

PART 2. PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Belden
B. Cerrowire
C. General Cable
D. Okonite Company
E. Service Wire Drive VFD Cable
F. Southwire

G. Or approved equal

2.02 MATERIALS AND EQUIPMENT

A. Design:

1. Provide cable designated as THWN/THHN or XHHW single conductor type and UL 83 and UL 1063 listed, rated 600 volts and certified for continuous operation at maximum conductor temperature of 90° C in dry locations and 75° C in wet locations while installed in underground duct, conduit or in control panels (MTW). Use XHHW, 90° rated conductors for main service or feeders

2. Provide cable with the following design characteristics. The cable shall consist of multiple conductors. The cable assembly shall be UL listed, flame, oil, and sunlight resistant, and certified for continuous operation at the temperature specified in wet or dry locations while installed in underground duct, conduit, or cable tray. The number and size of conductors supplied in each cable shall correspond to the quantities specified. Each conductor shall be individually insulated. Pairs and triads shall have conductors, which are twisted together with a drain wire, shielded, and covered with a jacket. Multi-pair/triad cables shall consist of the required number of electrically isolated, shielded pairs or triads, which are bundled together and covered by an overall jacket as specified

B. Conductors:

1. Provide conductors, which are Class B, concentric stranded, annealed un-coated copper with physical and electrical properties complying with ASTM B3 and B8 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516, unless otherwise specified

C. Insulation:

1. Each conductor shall be PVC insulated and nylon jacketed to meet the requirements of Part 3 of ICEA S-61-402. The insulation thickness shall match the dimensions listed in NEC Table 310-13 for type THHN and THWN wire

2. Each conductor shall be insulated as specified in compliance the requirements of Part 3 of ICEA S-61-402, S-66-524, or S68-516. The average insulation thickness shall not be less than the dimensions shown in Table 7-32 or 7.5.1 of ICEA S-66-524 or S-68-516 for 600-volt insulation unless otherwise specified. The minimum insulation thickness shall not be less than 90 percent of the value given in the table

D. Shielding:

1. Provide shielding consisting of laminated, non-burning, mylar-backed aluminum tape applied helically around a twisted pair or triad with the aluminum side in continuous contact with the drain wire unless otherwise specified. Wrap the tape around each twisted pair or triad with a 25 percent minimum overlap unless otherwise specified

E. Drain Wire:

1. Provide drain wire, which is Class B, seven-stranded, tin-coated copper in accordance with ASTM B3, B8, or B33 and as specified. The drain wire shall not be less than two AWG sizes smaller than the insulated conductor's size, except for multiple pair triad drain wires, which shall not be less than the insulated conductor size

F. Jacket:

1. The physical and electrical properties of the jacket used to cover single or multipair or triad cables shall meet the requirements of section 7.7.7 or ICEA S-66-524 or section 7.5.6 of ICEA S-68-516. Jacket material as specified. The jacket thickness shall be equal to the dimensions shown in Table 7-33 or 7.5.2 of ICEA S-66-524 or S-68-516

G. Armor:

1. Where requested, use instrumentation cables protected by an interlocked metal tape armor coating made of galvanized steel, which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524, unless otherwise specified

H. Wire Marking:

1. Wire marking shall be in accordance with NEC Article 310-11 and shall be printed on the wire insulation at 2-foot intervals
2. The printing method used shall be permanent and the color shall sharply contrast with the jacket color
3. Use individual conductors in single-pair and single-triad cables, which are, color coded black and white; and black, white and red, respectively. Multi-pairtriad cables shall have one conductor in each pair or triad colored white, and all other conductors are color coded in sequence according to Table L-2 of Appendix 2 of ICEA S66-524, and as specified
4. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with color sharply contrasting the jacket color

I. The single conductor color coding shall be as follows:

System Voltage	A	B	C	Neutral
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w	Brown	Purple	Yellow	Grey
Motor Control	1 Black			
	2 Red			
	3 Blue			

Ground	Green

J. VFD cables are to be selected and provided for AC motor drive duty and shall be rated at voltage listed in VFD Manufacturer's data sheets

K. All service and feeder conductors to be XHHW-2

L. All conductors shall be soft-drawn, stranded annealed copper that meets ANSI 44, ASTM B3-74/38-72

M. Insulation for all 480Vconductors, insulated equipment grounding conductors and control conductors shall be type XHHW-2 For dry and wet locations; maximum operating temperature shall be 90°C. Meet UL 44 and Federal Spec A-A-59544

N. All power conductor cables shall have phase colored insulation

O. Insulation for all 120/240V conductors, insulated equipment grounding conductors and control conductors shall be type XHHW-2 For dry and wet locations; maximum operating temperature shall be 90°C. Meet UL 44 and Federal Spec A-A-59544

P. Multiconductor shielded cables shall be polyethylene insulated tinned copper conductors within an aluminum-polyester shield tinned copper drain wire and a chrome PVC jacket. Shield shall provide 100% coverage. Cables shall be UL style 2092 and shall be Beldon Beldfoil #8760 or equal, with number of conductors shown. Minimum conductor size shall be #18AWG

Q. Multiconductor signal cables shall consist of twisted pairs of insulated copper conductors, size and number of pairs as indicated, with a petroleum-polyethylene compound which fills all cable interstices, a non-hygroscopic core tape, .005" copper shield and a polyethylene jacket. Cable shall be manufactured to REA Specification PE-39 for REA designation BJCF cables and shall be Okonite type KTC-F or equal

R. All control panel wiring shall be tinned stranded #14 AWG minimum size conductors for controls with type SIS insulation

S. Ethernet cable to be CAT6

2.03 INSULATING PRODUCTS

A. Tape products shall be furnished as hereinafter specified and shall be Plymouth, Okonite, F.E., 3M, or equal

B. General purpose electrical tape shall be 7 mil thick stretchable vinyl plastic, pressure adhesive type, "slipknot Grey", 3M Scotch 33+, or equal

C. Insulating void-filling tape and high voltage bedding tape shall be stretchable ethylene propylene rubber with high-tack and fast fusing surfaces. Tape shall be rated for 90 degrees Celsius continuous, 130 degrees Celsius overload, and shall be moisture-proof void filling tape shall be "plysafe", 3M Scotch 23, or equal

D. High temperature protective tape shall be rated 180 degrees Celsius continuous indoor/outdoor, stretchable, self-bonding silicone rubber. High temperature tape shall be "Plysil #3445", 3M Scotch 70, or equal

E. Insulation putty filler-tape shall be Plymouth #2074, 3M, or equal

2.04 WIRING DEVICES

A. All wiring devices shall be specification grade and shall meet NEMA WD 1-1971 requirements. Furnish following types unless otherwise indicated

B. GFI receptacles shall be 20A duplex receptacle in a duplex body containing reset and test pushbuttons. Furnish Square D "GFCI-WR", or equal

C. Single-pole, single throw, 20A toggle switch shall be Arrow-Hart #1791, Hubbell #1221, or equal

D. Door switch, single-throw pressure sensitive shall be Pass & Seymour #1205, or equal

E. Wiring devices are to be ivory in color

2.05 MISCELLANEOUS MATERIAL

A. Cable grips shall be 316 stainless steel, grip-type wire mesh with machined metal support. Furnish Kellems, Appleton, or equal products

B. Conduit pull-cords for use in empty raceways shall be glass-fiber reinforced tape with foot-marked along its length. Furnish Thomas, Greenlee, or equal products

C. Conduit thread coating compound shall be conductive, non-galling, and corrosion-inhibiting and applied to all threads. Furnish Crouse-Hinds type "STL", Appleton type "ST", Noalox, Penetrox or equal

D. Wire pulling compound shall be non-injurious to insulation and to conduit and shall be lubricating, non-crumbling, and non-combustible. Furnish clear wire pulling compound

E. Plastic compound for field-coating of ferrous material products shall be PVC in liquid form that sets-up semi-hard upon curing. Furnishing Rob Roy "rob Kote", Sedco "Patch Coat", or equal

F. Zinc spray for coating electrogalvanized steel products shall be Research Laboratory type "LPS", Mobil "Zinc-spray", or equal

G. Splicing kit shall be provided with insulating and sealing compound to provide a moisture-tight splice. Provide Scotchcast Series 82 or equal splicing kit

2.06 CONNECTORS

A. Power connectors shall be insulated tap connectors. Furnish NSI Polaris connectors with no equals

B. Insulated silicone filled spring-wire connectors, "wire-nuts", for small building wire taps and splices shall be plated spring steel with thermoplastic jacket. Connector shall be rated at 150 degrees Celsius continuous. Furnish 3M "or equal

C. Insulated set-screw connectors shall consist of copper body with flame-retardant plastic insulated shield. Furnish Ideal, T&B, or equal

D. Connectors for control conductor connections to screw terminals shall be crimp-type with vinyl insulated barrel and tin-plated copper ring-tongue style connector. Furnish T&B "Sta-kon", 3M "Scothlok", or equal

2.07 VFD RATED CABLE AND CONNECTORS

A. General

1. Provide power and control multiconductor and connector system for variable frequency drives with service in a corrosive industrial environment up to 600V AC.

B. Scope

1. (3) copper phase conductors with 2kV RHW-2 90° C insulation
2. (3) equally spaced bare copper equipment grounding conductors
3. Helically applied copper tape shield with minimum 50 percent overlap
4. Outer jacket
5. Connectors and accessories
6. Termination Kits
7. The minimum cable bending radius shall be a maximum of 10 times the overall cable diameter

C. Conductors

1. Conductor shall be the size specified, made of soft annealed stranded bare or tinned copper with Class B concentric stranding in accordance with ICEA (Insulated Cable Engineers Association) S-95-658, Tables 2-1, 2-3, and G-2.

D. Conductor Insulation

1. Phase conductor insulation shall be moisture resistant, flame-retardant cross-linked polyethylene (2kV RHW-2) suitable for 90° C conductor temperature operation in dry, damp and wet locations. Thermoplastic and non-flame-retardant insulations are not acceptable. The minimum insulation thickness shall not be less than 90% of the minimum average thickness shown in Section 6.0.

E. Fillers

1. Fillers of nonconductive and nonmetallic material may be cabled with the conductors to make the finished cable round and firm at all points as described in UL 1277, section 10.2.1.

F. Ground Wires

1. Ground wires for (3) conductor cables shall be three bare or tinned copper wires, one located in each interstice and equidistant from the phase conductors.

G. Shield

1. A copper tape shield shall be provided over the cable core and below the outer jacket. The tape shield shall be helically applied minimum 5 mils thick bare copper with minimum 50% overlap to assure full coverage at the cable bends.

H. Outer Jacket

1. The outer jacket shall be solid black and shall be moisture, chemical and sunlight resistant. Thermoset (e.g. CSPE or CPE-TS), thermoplastic (e.g., PVC or CPE-TP) and Low Smoke Zero Halogen (LSZH) jacket materials are acceptable. The minimum jacket thickness shall meet or exceed the requirements of ICEA S-93-658, Table 4-4.

I. Identification

1. Identification shall consist of readable printing on the cable jacket indicating number and size of conductors, cable type, voltage, UL listing, manufacturer's cable number and name, and year of manufacture.

2. Phase identification shall comply with either ICEA method 3 (black, red and blue insulation) or method 4 (surface printing of numbers).

J. Connectors

1. The cable systems' connectors shall be watertight, and UL listed for installation.

2. The connector body material shall be nickel clad aluminum. The cable connector shall provide a 360-degree electrical bonding of the copper tape shield to the connector body.

3. Connection of the copper tape shield to the connector body shall be accomplished by an integral and self-retaining grounding collar that automatically provides a 360-degree connection as the connector is tightened. The connector assembly shall be designed to ensure against loosening of threads due to vibration.

4. A UL listed chrome plated grounding and bonding locknut with a 360-degree knurled teeth connection shall be provided with each connector to secure and bond the connector to the inverter cabinet / motor termination box. In addition, tinned copper braids (minimum ¾ inches wide) with installation hardware to connect the copper tape shield to the inverter enclosure / backpanel and to the motor frame shall be provided as part of the cable system.

K. Termination Kits

1. Tinned copper braids (minimum ¾ inches wide) with installation hardware to connect the copper tape shield to cable core, to the inverter enclosure / back-panel, and to the motor frame shall be provided as part of the cable system.

2. Braid width shall be determined by cable core diameter size and shall be placed at a separation of 180 degrees.

L. DOCUMENTATION

1. The cable manufacturer shall provide clear and concise cable / connector installation instructions (including cable termination / connector assembly instructional DVD) and generic guidelines on how to ensure a long-term high frequency bond connection between the motor frame and drive backplane. The vendor shall furnish pictures of typical installations with proper high frequency bonding.

PART 3. EXECUTION

3.01 TESTING

A. Tests:

1. In general, test insulation integrity of the wiring system before terminating
2. Make sure to disconnect sensitive electronic equipment before testing insulation
3. Use a 500 VDC megohmmeter and perform the wire system insulation test in accordance with the operating instructions
4. Before connecting the cables, test insulation integrity and conductor continuity
5. All cables shall have an insulation test performed using 1000-volt megger that has been calibrated within the last twelve months.
6. Cables installed with an insulation reading less than 500 megohms shall be removed and new cable installed and retested at no additional cost to the owner.
7. Cables installed with an unacceptable insulation reading shall be removed and new cable installed and retested at no additional cost to the owner. Submit cable megger test report to owner's representative.
8. The grounding system shall be be tested in the presence of the owner's representative using the fall of potential method and shall provide a grounding system resulting in an ohmic value of five (5) ohms or less at no additional cost to the owner. The contractor shall submit test report to owner's representative. Test equipment must be calibrated within the previous 12 months. Provide dated calibration results along with submittal.

3.02 PREPERATION

A. Ship wire and cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture

protection by using manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable

B. Complete the cable raceway systems and underground duct banks before installing cables

C. Verify sizing of raceways and pull boxes to ensure proper accommodation for the cables

D. Check the length of the cable raceway system against the length of cable on the selected reel

E. Clean conduits of foreign matter before cables are pulled

F. Preparation for termination:

1. Make 600-volt power cable terminations and splices with heat shrinkable sleeves and seals
2. Terminal lugs and connectors for all sizes of conductors shall be crimp-on type
3. For size 1/0 AWG and larger, crimp-on lugs shall have the long barrel with 2-hole tongues except in places where termination space is limited

G. Do not install or work on PVC insulated or jacketed cables in temperatures below 32-degrees F

H. Provide at least 30 percent spare conductors or pairs

3.03 INSTALLATION

A. Wiring Methods

1. Use wiring methods indicated on the Drawings
2. In general, use THHN/THWN or XHHW building wire for lighting, power and control wiring where conductors are enclosed in raceways such as above ground conduit system, underground duct banks, or inside control panels. Use XHHW, 90° rated conductors for main service or power and motor feeders
3. Do not use solid conductors
4. Use conductors no smaller than No. 12 AWG stranded for lighting circuits indoors and not smaller than No. 10 AWG stranded for outdoors. Use No. 10 AWG (minimum) for outdoor receptacles on structures or poles
5. Use conductors no smaller than No. 14 AWG for control circuits, except when part of a multi-conductor cable or internal panel wiring
6. In general, do not splice conductors. All conductors must be one continuous length from starting point to end point without splices, unless prior written approval by Engineer
7. Splices associated with taps for lighting and control circuits are allowed without approval

8. Make splices in accessible junction boxes located above ground. Do not splice power and control conductors in underground pull boxes or manholes, unless specifically allowed. Any slices allowed in underground boxes shall be made using 3M liquid tight kits specifically made to withstand submergence in water. Any conductors allowed to be spliced in underground boxes shall have conductors elevated to near top of wall
9. Wire nuts with insulated caps may be used for lighting wiring splices located in wall boxes, switch boxes, and receptacle boxes, but not in control panels, MCC's or underground boxes. Splice control circuit with insulated crimp connectors
10. All conductors routed in manholes, electrical vaults and underground pull boxes shall be routed around walls and supported by nonmetallic fiberglass strut that is bolted vertically to walls at intervals not less than two per wall. Do not use horizontal arms unless specifically called for. Support conductors with stainless steel bands made for the purpose of supporting conductors, or with large wide nylon Ty-Wraps. Under no conditions shall conductors be routed directly across length of box. Any conductors routed otherwise shall be removed and replaced at Contractors expense. Splicing in UG pull boxes, manholes or vaults is prohibited without written approval by Engineer

B. Single Conductor in Conduit and Ductbank

1. Install cables in accordance with the manufacturer's instructions and NEC Chapter 3 - Wiring Methods and Materials. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius
2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation
3. Splices are not allowed in manholes

C. Single Conductor in Cable Tray:

1. Do not install single conductor building wire and cable in cable tray. All conductors to be tray rated composite cable type

D. Multi-Conductor Shielded VFD Rated Cable:

1. Install cables in accordance with the manufacturer's instructions
2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation
3. Do not splice cables unless specifically shown on plans. Provide as one continuous length. Where splicing is shown on plans or approved, use mechanical compressing tools and splice barrels only, and tape connections
4. All cables and conductors routed thru UG pull boxes or manholes shall be routed around walls and secured on racks. See plans for details

E. Termination:

1. After the 600-volt wiring system has been tested with satisfactory results, reconnect wire
2. Do not splice conductors. For termination use crimp-on type ring tongue non-insulated tin-plated copper lugs
3. For shielded control cable, terminate the shield and ground it at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables
4. If splicing is required, maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground
5. Mark wiring on both ends with circuit numbers or loop tag numbers. Heat shrink wire markers after the ring tongue terminal has been installed. Extend the marker over the crimp or base of the terminal

F. Conductors shall be sized as shown and where no size is indicated, the conductor size shall be size #12 AWG

G. Insulation for all conductors, insulated equipment grounding conductors and control conductors shall be stranded copper type XHHW-2 for dry and wet locations; maximum operating temperature shall be 90°C (XHHW-2). UL listed as gasoline and oil resistant. PVC insulation with nylon outer jacket. Meet UL 83 and Federal Spec J-C-30B

H. Branch circuits may be spliced for receptacle and lighting loads inside appropriate junction boxes. All control and power cables shall be run continuous without splices except where approved by the engineer

I. Except as otherwise specified, taps and splices for receptacles and lighting shall be made with silicone filled spring wire connectors

J. Motor connections and all taps and splices other than for receptacle and lighting shall be made with the appropriate NSI Polaris series connectors

K. Control wiring connections to stud type and screw type terminals shall be made with ring-tongue type crimp connectors. Label each terminal jacket with wire marking label at each connection

L. Each wire connection shall be made up tightly so that resistance of connection is as low as equivalent length of associated conductor resistance

M. All wiring inside enclosures will be neatly trained and laced with nylon tie-wraps

N. All wiring shall be installed in raceways except inside the wet well; however, no wire shall be drawn into a conduit until all work of a nature which may cause injury is completed. Do not exceed wire and cable manufacturer's recommended pulling tensions. A cable pulling compound shall be used as a lubricant and its composition shall not affect the conductor or its insulation

O. Install wiring devices where indicated. Wiring devices shall be type as indicated

P. Each wiring device shall be set with axis plumb and installed with yoke screw so as to adequately support device yokes to the box. Install ground prong pointed up

Q. Device boxes shall be type FS or FD cast aluminum

R. Use aluminum ganged boxes for ganged devices. “Type FD sand cast aluminum boxes are required

S. Each device box shall be equipped with specified aluminum cover and 316 S.S. hardware

3.04 REPAIR/RESTORATION

A. Inspection of Conductors

B. All conductors shall be inspected for damage after pulled in conduit. Where damage is deemed excessive by Engineer, conductors shall be replaced for entire length of run

C. Where damage is due to condition of conduits, Contractor may be requested to provide a televised inspection of conduits at no additional cost to Owner and where deemed necessary by Engineer, any damaged conduits shall be replaced at no additional cost to Owner

END OF SECTION

Section 16131

Raceways and Boxes

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. This specification will cover device boxes, pull boxes, junction boxes, and raceways not covered in other sections

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. FB1 - Fittings and Support for Conduits and Cable Assemblies
2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Article 314 – outlet device, pull and junction boxes, conduit bodies and fittings

C. Underwriters Laboratories (UL):

1. 50 - Safety Cabinets and Boxes
2. 508 - Safety Industrial Control Equipment
3. 514B - Safety Fittings for Conduit and Outlet Boxes
4. 886 - Safety Outlet Boxes and Fittings for Use in Hazardous Areas.

1.03 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

B. Installation instructions

C. Dimensions and weights

1.04 RECORD DRAWINGS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.05 OPERATIONS & MAINTENANCE MANUALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

PART 2. PRODUCTS

2.01 ACCEPTABLE MANUFACTURER'S

A. Sheet Metal Boxes
   1. Hoffman Industrial Products
   2. Robroy
   3. Eaton/Crouse-Hinds
   4. Rittal

B. Cast Device Boxes
   1. Appleton Electric Company
   2. Eaton/Crouse-Hinds
   3. Hubbel/Killark

C. Pull box
   1. Oldcastle
   2. Cesco
   3. Rexel USA
   4. Utility Concrete Porducts
   5. Jensen Precast
   6. Or approved equal

2.02 MATERIALS AND EQUIPMENT

A. Sheet metal boxes
   1. Provide UL-approved junction boxes and pull boxes manufactured from stainless steel sheet metal and meeting requirements of NEMA 4X for corrosive and wet areas, NEMA 250 and NEC Article 314. Enclosures located outdoors or in environmentally harsh or wet locations shall be NEMA 4X 316 stainless steel
   2. Provide boxes with a stainless-steel continuous hinge, closure hasps and all stainless-steel hardware
   3. Furnish the door with neoprene gasket and provision for padlock

B. Device boxes
   1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 314

2. Supply boxes that are hot dip galvanized on cast iron suitable for corrosive and wet atmosphere
3. All boxes located in environmentally harsh or wet or outdoor locations shall be NEMA 4X 316 stainless steel
4. All boxes located in chemical rooms shall be H.D. PVC only
5. Where unprotected service conductors are routed through a pull box with other conductors a divider wall shall be provided in the pull box for separation as required by the NEC

C. Hardware
1. Mounting Hardware: Stainless steel
2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal

D. Pull Box
1. Minimum size 24” x 24”
2. Pull box shall be traffic rated
3. Pull box shall be aircraft rated where shown on plans
4. Modular construction
5. Base/bottom section
6. Lockable cover

PART 3. EXECUTION

3.01 PREPERATION

A. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling, and storage

B. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient

3.02 INSTALLATION

A. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations

B. B. Install boxes in accordance with NEC Article 314 in locations indicated on the Drawings

C. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance, and repair

D. Plug unused conduit openings

E. Make conduit connections to sheet metal boxes with watertight conduit connectors

F. Size underground pull boxes and manholes large enough to allow cables and conductors to be routed around walls and supported on wall racks. See plans for details. Do not use arms on mounted racks, except for MV cables or large multiple 600 Volt cables. Do not cross and occupy middle of pull box or manhole with cables or conductors

END OF SECTION

Section 16132

Conduit, Fittings, and Bodies

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. This specification covers all requirements for conduits, fittings, and bodies for various service and electrical equipment

D. All equipment described herein shall be submitted, and factory installed, as an integral part of equipment specified in overall construction documents

1.02 PRICE AND PAYMENT PROCEDURES

A. No separate payment for work performed under this section. Include cost for conduits, fittings, and bodies in overall electrical equipment

1.03 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI C80.1: Rigid Steel Conduit - Zinc Coated
2. ANSI C80.4: Fittings for Rigid Metal Conduit

B. Federal Specifications

1. W-C-58C: Conduit Outlet Boxes, Bodies Aluminum, and Malleable Iron
2. W-C-1094A: Conduit and Conduit Fittings Plastic, Rigid
3. WW-C-566C: Flexible Metal Conduit
4. WW-C-581E: Coatings on Steel Conduit

C. National Electrical Manufacturers Association (NEMA)

1. NEMA RN1: Polyvinyl Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
2. NEMA TC2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
3. NEMA TC3: PVC Fittings for Use with Rigid PVC Conduit and Tubing

D. National Fire Protection Association (NFPA), ANSI/NFPA 70 - National Electrical Code (NEC)

E. Underwriters' Laboratories (UL)

1. UL 1: Flexible Metal Electrical Conduit
2. UL 6: Rigid Metal Electrical Conduit
3. UL 514B: Fittings for Conduit and Outlet Boxes
4. UL 651: Schedule 40 and 80 Rigid PVC Conduit
5. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit
6. UL 886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations

F. ETL verified PVC-001 for PVC coated rigid steel conduit

1.04 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.05 RECORD DRAWINGS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.06 OPERATIONS & MAINTENANCE MANUALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.07 QUALITY ASSURANCE

A. Tests:
1. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C80.1
2. Flexible conduit shall pass the tension, flexibility, impact, and zinc coating test described by UL 1
3. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC2, UL 651 and 651A and Federal Specification W-C-1094A

PART 2. PRODUCTS

2.01 RACEWAYS

A. Acceptable manufacturer’s
1. Cantex
2. Wheatland Tube
3. ABB - Ocal
4. Champion Fiberglass
5. NEC Inc., - Black Guard
6. Atkore - Heritage Plastics

7. Allied Tube & Conduit
8. Prime Conduit
9. Emerson - O-Z/Gedney
10. Eaton/Crouse-Hinds
11. Western Tube and Conduit
12. Robroy – Plasti-Bond
13. Or equal

B. Materials and equipment

1. Design Conditions. Use electrical conduit, fittings, and bodies designed for service in areas as specified within this section to form a continuous support system for power, control, and instrument cables
   a. Use PVC coated steel conduits and hardware for Wastewater Facilities or corrosive environments
   b. Use rigid galvanized steel conduits for Water Facilities
2. Conduit and Fittings
   a. Fiberglass Conduit – Above Ground
      i. Listing: UL 2515 Above Ground Standard
      ii. RTRC (Thermosetting Resin Conduit) manufactured by single circuit filament winding process. The resin shall be epoxy based, with no fillers.
      iii. Manufacturer shall have a current ISO 9001 Quality Management System Certificate
      iv. Toxicity: The conduit shall not contain any compounds that can release halogens (chlorine, bromine, flour, and iodine) in more than trace amounts when burning.
   b. Fiber Glass conduit – XW Conduit
      i. RTRC (Thermosetting Resin Conduit) manufactured by single circuit filament winding process. The resin shall be epoxy based, with no fillers.
      ii. Manufacturer shall have a current ISO 9001 Quality Management System Certificate
      iii. Toxicity: The conduit shall not contain any compounds that can release halogens (chlorine, bromine, flour, and iodine) in more than trace amounts when burning.
      iv. Wall thickness: Minimum of .25”
   c. PVC-Coated Rigid Steel Conduit and Fittings.
      i. PVC-coated conduit, fittings, bodies, and covers shall conform to NEMA RN1 (Type A). Rigid steel galvanized conduit and fittings

before coating shall conform to Federal Specification WW-C-581E, ANSI C80.1, and UL 6. Conduit bodies shall conform to UL 514B and Federal Specification W-C-58C. Provide sufficient coating for touch up after installation

ii. PVC-coated couplings shall be of the ribbed type

iii. Condulet covers shall have encapsulated stainless steel thumbscrews

iv. Condulets and covers shall be of malleable iron or feraloy material before coating

v. PVC coating shall be a minimum of 2-mil thickness on the interior of the conduit and the interior of fittings, condulets, covers, and bodies

vi. Conduit clamps, strut, and devices shall be PVC coated when used with PVC-coated conduit

d. Flexible and Liquid tight Flexible Metal Conduit and Fittings

i. Use liquid tight flexible metal conduit manufactured in accordance with UL 1 and Federal Specification WW-C-566C

ii. Fittings used with liquid tight flexible metal conduit shall be the PVC- coated type and of such design as to thoroughly ground the conduit to the fittings and through it to the box or enclosure to which it is attached

iii. Liquid tight flexible couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501-10 (A&B), and Federal Specification W-C-586C

iv. Do not use flexible metal conduit or liquid tight flexible metal conduit for light fixtures or receptacles unless shown on plans or approved by Engineer

e. PVC Conduit and Fittings. Use PVC conduit, bends, and fittings, which comply with NEMA TC2, W-C-1094A, and NEC Article 352-III for above ground and underground installation. Conduit shall be Schedule 80, unless shown or noted otherwise on drawings or in other specifications

f. Use PVC Schedule 80 conduits, fittings, and boxes for all chemical areas and provide conduit seals per NEC

g. Aluminum RMC conduit may be used only where shown on plans

h. Do not use liquid tight flexible metallic conduit to connect rigid conduit to fixed or wall mounted enclosures or panels

i. Do not run liquid tight flexible metallic conduit directly thru walls, ceilings, or floors.

j. Do not attach liquid tight flexible metallic conduit with nylon or plastic tie- wraps on straps. Use aluminum straps made for that purpose, except where approved by Engineer.

C. Use UNY or UNF aluminum unions

D. Conduit entrances into equipment shall be carefully planned. Cutting away of enclosure structure, torching out sill or braces, and removal of enclosure structural members, will not be acceptable

E. Below-grade to above-grade upturns in non-metallic runs shall be made with ETL-PVC-001 compliant PVC coated rigid metallic conduit including 90-degree bends

F. Above ground conduit shall be pvc coated rigid galvanized steel 1 in. minimum and shall comply with Article 346 of NEC and U.L. standard UL-6.

G. Below grade conduit shall be non-metallic rigid PVC Schedule 80 1 in. minimum, rated 90 degrees Celsius and conform to NEMA TC-2 and UL-651 Standards, transitions to above ground to be made with PVC coated hot dipped rigid steel conduit that is ETL-PVC-001 compliant.

H. Limited use of flexible conduit may be allowed if approved by the inspector. Use type LFNC flexible seal tight for 3/4 in. minimum thru 2 in. sizes, connectors shall be UL listed. Use aluminum core liquid tight flexible metal conduit for sizes 2 1/2 in. and larger, connectors shall be aluminum. All conduit shall be mounted on strut

2.02 CONDUIT FITTINGS

A. Field applied hubs for all enclosure type entries shall be aluminum with grounding type lock ring, nylon throat, threaded NPT insert and shall be MYERS "SCRU-TITE", or equal

B. Rigid metallic conduit chase nipples, slip fittings, unions, reducers shall be aluminum

C. Limited use of flexible conduit may be allowed if approved by the inspector. Use type LFNC flexible seal tight for 3/4 in. minimum thru 2 in. sizes, connectors shall be UL listed. Use aluminum core liquid tight flexible metal conduit for sizes 2 1/2 in. and larger, connectors shall be aluminum. All conduit shall be mounted on strut

2.03 BODIES AND BOXES

A. Conduit bodies such as "C", "LB", "T" and the like pulling fittings shall be sand-cast copper free steel. Covers shall be gasketed 316 stainless steel cover screws and clamp style attachment. Furnish Crouse-Hinds Form 7, or equal

B. Cast metal outlet boxes, pull boxes, and junction boxes whose volume is smaller than 100 cubic inches, and cast metal device boxes, shall be sand-cast copper free. All boxes shall have threaded hubs. Furnish Crouse-Hinds "FD" style Condulets, Appleton "FD" style Unilets, or equal

C. Covers for cast aluminum boxes shall be gasketed aluminum covers with 316 stainless steel screws. Furnish Pass & Seymor series WIUCast for receptacle covers and Cantex single gang toggle switch covers for light switches

PART 3. EXECUTION

3.01 PREPERATION

A. Package conduit in 10-foot bundles maximum with conduit and coupling thread protectors suitable for indoor and outdoor storage. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage. Package plastic-coated rigid conduit, fittings, and bodies in such a manner as to protect the coating from damage during shipment and storage

B. Store conduit above ground on racks to prevent corrosion and entrance of debris

C. Protect plastic conduit from sunlight

D. Confirm submittal of shop drawing with conduit and conduit fitting, sizes, types, and routing shown

E. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements

F. Verify the actual physical conduit route from the conduit plan drawings and prepare the conduit support system

G. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.

H. Submit layout of all conduit stub-ups for Engineers review before installing conduits. Do not install conduit to equipment, electrical panels or devices until enclosure locations and sizes have been determined and verified by Supplier.

3.02 INSTALLATION

A. Conduit bodies such as "LB", "T", etc., shall be installed in exposed runs of conduit wherever indicated and where required to overcome obstructions and to provide pulling access to wiring. Covers for such fittings shall be accessible and unobstructed by the adjacent construction. All conduit fittings shall be form 7 sand cast aluminum with aluminum covers and 316 S.S. hardware

B. Covers for conduit bodies installed shall match the conduit material being installed

C. No more than 270 degrees of bends shall be used in conduit runs

D. Empty conduits shall have pull-tape installed. Identify each terminus as to location of other end. Use blank plastic waterproof write-on label and write information on each label with waterproof ink. Cap exposed ends of empty conduit with threaded plastic caps

E. Conduit runs into boxes, cabinets, and enclosures shall be set in a neat manner. Vertical runs shall be set plumb. Conduits set cocked or out of plumb will not be acceptable. Use aluminum grounding type myers hubs with insulated throats for all enclosure entries

F. All raceways shall be swabbed clean after installation. There shall be no debris left inside. All interior surfaces shall be smooth and free from burrs and defects that would injure wire insulation. All conduits shall be sealed after cable installation with electrical insulation putty

G. Each flex connector shall be made-up tightly so that the minimum pull-out resistance is at least 150 lbs.

H. Rigid metallic conduit runs shall have their couplings and connections made with screwed fittings and shall be made up wrench tight. Check all threaded conduit joints prior to wire pull

I. All conduit runs shall be watertight over their lengths of run except where drain fittings are indicated. In which cases, install specified breather-drain fittings. Use aluminum seal-off fittings where required by NEC. Seal with 3M-2123 re-enterable sealing compound

J. LFNC conduit shall be used to connect wiring to limit switches, bearing thermostats, and other devices that may have to be removed for servicing. Unless otherwise indicated, maximum lengths of flex shall be six (6') feet

K. Install the conduit system to provide the facility with the utmost degree of reliability and maintenance free operation. The conduit system shall have the appearance of having been installed by competent workmen. Kinked conduit, conduit inadequately supported or carelessly installed, do not give such reliability and maintenance free operation and will not be accepted

L. Raceways shall be installed for all wiring runs

M. Conduit sizes, where not indicated, shall be N.E.C. code-sized to accommodate the number and diameter of wires to be pulled into the conduit. 3/4" trade-size shall be minimum size conduit except for conduits installed in duct banks which shall be a minimum 1” trade-size

N. Unless otherwise noted, conduit runs shall be installed exposed. Such runs shall be made parallel to the lines of the structure. Aluminum rigid conduit shall not come in contact with concrete

O. All raceway systems shall be adequately and safely supported. Loose, sloppy and inadequately supported raceways will not be acceptable. Supports shall be installed at intervals not greater than those set forth under Article 300 of N.E.C., unless shorter intervals are otherwise indicated, or unless conditions require shorter intervals of supports

P. Surface mounted runs of conduit on concrete or masonry surfaces shall be supported off the surface by means of 316 stainless steel slotted channels and conduit clamps. Attach each slotted channel support to concrete surface by means of two (2) 1/4" diameter 316 stainless steel bolts into drilled expansion shields

Q. Conduit runs that are installed along metallic structures shall be supported by means of 316 S.S. beam clamps or other methods as may be indicated

R. Below-grade conduits shall be supported with plastic saddles

S. Install PVC-coated conduits in all locations at wastewater facilities, inside valve vaults, in wet well slabs, in corrosive and wet environments, in chemical rooms (Schedule 80 required) and, where specifically noted on drawings. Aluminum PVC- coated conduit may be used where specifically shown on plans, where

specifically noted in specifications or where approved in writing. Install PVC coated conduits in Water Facilities where wet locations, inside valve vaults, or where specifically shown on Plans or noted in other Specifications

T. Install rigid galvanized steel (RGS) conduits in dry inside locations and in all outdoor locations for water facilities and, where specifically noted otherwise on drawings. Aluminum RMC may be used where specifically shown on plans, where specifically noted in specifications or where approved in writing. Where aluminum conduit is approved, use all aluminum condulets and fittings

U. Install PVC conduits in duct banks. For stub-ups and directional turn elbows, use PVC-coated rigid steel elbows or rigid steel elbows as applicable in A and B above and other specifically noted locations on drawings. Rigid steel stub-up shall have minimum three (3) layers of mylar tape up to 1" above slab where conduit is in contact with concrete. Stub-ups inside MCC's, panels, equipment and/or enclosures shall have threads with grounding bushings installed. Stub up all conduits entering MCC's, and other equipment enclosures from the bottom into each respective starter, feeder breaker or control section per equipment manufacturers conduit layout detail. Coordinate with equipment manufacture data sheets before starting any underground or below slab conduit installations

V. Run exposed conduit parallel or perpendicular to walls, ceilings, or main structural members. Group multiple conduits together where possible. Do not install conduit where it interferes with the use of passageways, doorways, overhead cranes, monorails, equipment removal areas or working areas. In no case shall conduit routing present a safety hazard or interfere with normal plant operating and maintenance procedures. Maintain a minimum overhead clearance of 8'0" in passageways. Except where absolutely impossible, all conduits are to be installed in or under concrete slab, in walls and ceilings. Any exposed conduit installed otherwise may be relocated at Contractor's expense where directed by Engineer or Owner. Exceptions, where specifically noted otherwise on plans

W. Installation and support of conduit shall be from steel or concrete structures in accordance with the standard detail drawings. Furnish necessary conduit straps, clamps, fittings and support for the conduit in accordance with the standard details and consistent with the grade and type of conduit being installed

X. Identify conduit at termination points like MCC, light fixtures, control panels, receptacles, and junction boxes. Tag all conduits per Section 16052 – "Electrical Identification."

Y. Not more than three (3) equivalent 90-degree bends will be permitted between pull boxes, or between pull boxes and equipment. Provide bonded expansion fittings at building expansion joints. Where pull boxes are located such the three 90-degree bend rule is not exceeded without the pull box, the box may be deleted where approved by Engineer in writing

Z. Install conduit runs so that they are mechanically secure, mechanically protected from physical harm, electrically continuous, and neat in appearance. The interiors of conduit shall provide clean, smooth raceways through which conductors may be drawn without damage to the insulation. Make threaded connections wrench tight

AA. Cut conduit square with a power saw or a rotary type conduit cutter designed to leave a flat face. Do not use plumbing pipe cutters for cutting conduit. Ream the cut ends of conduit with a reamer, designed for the purpose to eliminate rough edges and burrs. Cut threads with standard conduit dies providing 3/4-inch taper per foot, allowing the proper length so that joints and terminals may be made up tight and the ends of the conduit not deformed. Keep dies sharp and use a good quality threading oil continuously during the threading operation. Remove metal cuttings and oil from the conduit ends after the threads are cut and paint threads before connections are made. Use zinc rich, brush-on compound on the threads of steel conduit before connections are made. Use only tools specifically made for bending and installing PVC-coated or PVC conduit when installing these materials

BB. Use strap wrenches only to tighten joints in plastic coated rigid steel conduit. Replace all conduit and fittings with damage to the plastic coating, such as cuts, nicks and threader chuck jaw marks

CC. Make up changes in direction of exposed conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise. Do not use elbow bends for change in direction of exposed conduit

DD. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bend shall not be less than 6 times the smallest diameter of the raceway

EE. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign matter into the conduit system by properly capping terminations

FF. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a “tee” condulet equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 degrees F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side

GG. Fit conduit crossing building or structure expansion joints with approved expansion fittings, except that fittings will not be required when conduit crossing an expansion joint is supported on trapeze hangers in such a way that at no time will the conduit be under stress due to expansion. Install bonding jumpers around expansion joint fittings

HH. Where conduit terminates in sheet metal enclosures, threaded hubs are required. Conduit entries with double locknuts and bushings are prohibited. Sheet metal enclosures located outside or in any other wet, damp, or corrosive areas shall be furnished with threaded hubs. Restrict side penetrations to the lower one third of the enclosure

II. Provide liquid tight flexible metallic conduit only where necessary to allow for movement or to localize sound or vibration, at transformers, at motors, solenoid valves, motor operated valves, generators, and any other rotating equipment unless shown otherwise on Drawings. Do not make rigid connections of conduit to vibrating equipment housing or frame. Limit length to less than 2 feet. Do not use

flexible metallic conduit for light fixture circuits or similar devices and do not use as a substitute for rigid conduit

JJ. Seal openings or holes where conduits pass through walls or floors. When conduits are passing through a firewall or fire-rated floor into different rooms, cabinets, or enclosures, use a fire-rated seal as shown in the typical detail included in the drawings. Certain walls, where indicated on the Drawings, require environmental (airtight) seals; seal as shown

KK. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area, where shown on Drawings. Install type CSBE removable sealing fittings to seal pump cables in the wet well and at the first junction box outside the well. Install EYS seals in all conduits leaving chemical rooms or chemical storage spaces. There shall be no unions, couplings, boxes, or fittings in conduit run between seal and point at which conduit leaves the room

LL. Unless otherwise indicated on the Drawings, install expansion fittings every 300 feet within a straight conduit run and where conduit crosses building expansion joints, using bonding straps to ensure ground continuity

MM. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12 inches between racks, unless otherwise indicated on the Drawings. Space conduits on the racks at least enough to provide 1/4-inch clearance between hubs on adjacent conduits at terminations and to allow room for fittings

NN. Fill conduit racks no more than 75 percent of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so that future conduits may be installed in the space remaining. Construct conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks

OO. Where conduit racks are supported on rods from beam clamps or by some other non- rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack

PP. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members, process equipment, or access to anticipated future equipment. Refer to architectural, structural, equipment layout and piping drawings to ensure that this requirement is met

QQ. Label high voltage conduit with the circuit phase-to-phase voltage by means of a firmly attached tag or label of approved design at each conduit termination, on each side of walls or barriers pierced and at intervals not exceeding 200 feet along the entire length of the conduit

RR. Support conduit sizes 2 inches and larger at spacings not exceeding 10 feet and conduit sizes 1-1/2 inches and smaller at spacings not exceeding 8 feet

SS. The means of fastening conduit to supports shall be by one-hole malleable iron conduit straps secured by wood screws to wood and by bolts with expansion anchors to concrete or masonry; by “Korn” clamps or U-bolts to other surfaces.

Use “clamp backs” when strapping conduits to walls, column faces, or other such surfaces

TT. Support conduit runs with conduit clamps, hangers, straps, and metal framing channel attached to structural steel members. Conduits of 1-1/2-inch size or less may be supported by one-hole conduit straps on concrete, tile or steel work, but for larger size conduit, use 2-hole straps. Use clamps of galvanized malleable iron for rigid galvanized conduit and PVC-coated or stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be Type 316 stainless steel

UU. Install conduits supported from building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit. All conduits shall be routed below concrete floor slabs on grade and shall have sand fill and cover. Set depth to account for radius of turn-up to prevent exposure of elbow bend

VV. Where specifically shown on plans, size and space embedded conduits in structural slabs in accordance with the Uniform Building Code. Conduits should occupy no more than one-third the thickness of the slab and should not be closer than 3 times the largest diameter on center without additional reinforcement

WW. Do not cut paved driveways, sidewalks, concrete foundations, etc. to install conduits unless specifically noted on plans. Bore under such construction and maintain a minimum of 24 inches below underside of paving or concrete. Repair any cutting or damage to original condition and to satisfaction of Engineer and Owner

XX. All conduits for fiber optic cables are to have wide tube radius compatible with cable manufacturer’s requirements

YY. Damaged conduits shall be replaced at no additional cost to Owner where Engineer deems necessary because of extent of damage or, where conductors are damaged by defective conduit installation

ZZ. Seal all conduits entering motor control centers, control panels, equipment, enclosures, valve actuators, etc. with CSBE seals or, install EYS at locations permissible. Sealing glands shall be selected specifically for each conduit and conductor. Install seals at all equipment located at elevation lower than U.G. conduit route

AAA. Conduits penetrating underground pull boxes shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon-based sealant where smaller than 1 ¼-inch diameter

BBB. Conduits penetrating structural walls of lower levels shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon-based sealant where smaller than 1 ¼-inch diameter

CCC. All conduit duct banks penetrating lower level structures and penetrating underground pull boxes shall be sealed watertight between conduit and wall of structure or pull box

DDD. Where conduits are stubbed out from building for future use, extend conduits 5 feet past building wall or past edge of pavement, whichever is applicable. Do not leave under pavement. Cap ends of conduits

EEE. All conduits shown entering outside walls of buildings shall stub-up immediately adjacent to wall and penetrate low on wall. Where not shown entering wall, all conduits shall be routed up through building floor by excavating below foundation, core drill through floor, and stub-up conduits then backfill with cement stabilized sand, compacted in place

FFF. Apply a conductive coating to field-cut threads of aluminum conduits to ensure continuity and ease of joining. Noalox and Kopr-Shield are acceptable coatings

GGG. Avoid excessive force when tightening threaded fittings for aluminum conduit, both between conduits and at threaded box entries. Generally, the correct force is hand-tight plus one full turn with a wrench. At least three (3) full threads should be engaged

HHH. Do not use conduit bushings to secure threaded aluminum RMC to a box or enclosure. Install a locknut between a conduit bushing and the inside of the box or enclosure

III. Threadless fittings shall not be used with threaded aluminum conduit

JJJ. Install expansion fittings in outdoor runs of aluminum RMC

KKK. Do not install aluminum conduit in concrete or underground

LLL. Use special tools for installing aluminum conduit. All damaged conduits shall be replaced

MMM. In chemical rooms, enclosures, and portable/prefab buildings used for chemical storage or chemical equipment operation, use Schedule 80 PVC conduit and fittings only, except where specifically noted on Plans, use PVC coated steel conduit. Use PVC boxes and enclosures. There are no exceptions to this requirement unless specifically noted on drawings as an exception to this section

NNN. Do not route conduit on outside walls of buildings or structures unless specifically shown on Plans, route from floor slab. Do not route conduit on building interiors, MCC rooms or equipment rooms unless shown on Plans, or approved in writing. Exception: conduits to light fixtures on ceilings. Paint to match. Where shown on Plans or where approved, conduits shall be painted to match surface on which installed. Submit drawings or sketches of any conduit routing that varies from Plans or Specifications.

OOO. Where underground conduit ductbanks are routed under new building slabs greater than 4 inches thick, conduits may be encased in cement stabilized sand with red marking tape

PPP. Provide steel conduit for all security, fire, TV, and access control system circuits. Coordinate circuits and conduit requirements within respective vendors

QQQ. Paint all exposed conduit threads to prevent corrosion. Match color of conduit

RRR. Paint all exposed rigid steel surface mounted conduits in MCC rooms. Match wall and ceiling color

SSS. Where RGS conduit is installed on interior or exterior building walls (or ceilings), paint conduit, supports and clamps to match wall color

TTT. Contact Engineer for inspection of conduit stub-ups and U.G. ductbanks before concrete pour

UUU. Where RGS conduit is installed on interior or exterior building walls (or ceilings), paint conduit, supports and clamps to match wall color

VVV. For conduits that will contain coaxial cable or other wide radius band cables, provide wide sweep conduit elbows on bands that will accommodate pulling such cables thru 3 90 degree turns without exceeding band radius limitations.

END OF SECTION

Section 16133

Underground Ductbank

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only.

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid.

1.02 REFERENCES

A. National Fire Protection Association (NFPA): No. 70 - National Electrical Code (NEC) Appendix B

1.03 SUBMITTALS, RECORD DRAWINGS, AND O&M MANUALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

PART 2. PRODUCTS

2.01 ACCEPTABLE MANUFACTURER'S

A. Thomas and Betts

B. Underground Devices Inc.

C. Walker Division, Butler Manufacturing Company.

D. Carlon

E. Or approved equal

2.02 MATERIALS AND EQUPMENT

A. Conduit: Construct ducts using schedule 80 rigid PVC conduit

B. Spacers: Secure conduit with non-magnetic, universal, interlocking-type spacers for both horizontal and vertical duct arrangements

C. Concrete: Use steel reinforced, red concrete as duct encasement. Provide Class F concrete in non-truck traffic areas. Provide Class C concrete under gravel or asphalt driveways subject to heavy traffic

D. Where unprotected service conductors are routed through a pull box with other conductors a divider wall shall be provided in the pull box for separation as required by the NEC

PART 3. EXECUTION

3.01 PREPERATION

A. Have duct spacers and associated hardware packed and crated to avoid damage during shipment and handling

B. Clearly mark packages or crates stating that the material is for electrical duct banks only

C. Verify from Drawings and field survey that the location of ductbanks does not interfere with any existing or new underground facilities

D. Verify that materials are on site in proper condition and that sufficient quantity is on hand for the work

E. Verify that trenches are in the correct places and prepared with sufficient depth and width to accommodate the duct banks, reinforcing rod, and concrete

F. Be prepared for inspection of the duct banks before reinforcing rod is installed

G. Before pouring concrete, verify that the ducts are free of debris and properly installed in the support and spacer systems and that the ducts are properly fitted together and firmly held in place by the hold down hardware

H. Provide 24-hour notice to Engineer and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks

3.02 INSTALLATION

A. Conduit runs installed below-grade in earth shall be Sch 80 PVC. Use manufacturer's approved cement for joining couplings and adapters. Runs shall be installed so that top of concrete ductbank is a MINIMUM OF TWENTYFOUR (24") INCHES BELOW FINISHED GRADE. Support conduit runs on plastic spacers and encase conduits with 3000 PSI reinforced concrete dyed with red concrete dye at a rate of 12 pounds of dye per cubic yard of concrete. Provide clearances as shown on detail drawings. Cover top of concrete to finished grade with selected soil that is free from clods, debris, rocks and the like. Pneumatically tamp backfill in six (6") inches to eight (8") inches below finished grade, install continuous run of "BURIED ELECTRIC" marking tape and complete backfill to finished grade. Contractor’s means and methods shall prevent floating of conduit and rebar during concrete placement. Metal to metal contact between the earth and rebar cage is not allowed

3.03 EXCAVATION AND BACKFILLING

A. Do all excavating and backfilling necessary for the installation of the work. This shall include shoring and pumping in ditches to keep them dry until the work in question has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed

B. All excavations shall be made to the proper depth, with allowances made for floors, forms, beams, piping, finished grades, etc. Ground under conduits shall be well compacted before conduits are installed

C. All backfilling shall be made with selected soil; free of rock and debris and shall be pneumatically tamped in six (6") inch layers to secure a field density ratio of 90%

D. All excavated material not suitable and not used in the backfill shall be removed offsite at the Contractors expense

E. Field check and verify the locations of all underground utilities prior to any excavating. Avoid disturbing these as far as possible. In the event existing utilities are broken into or damaged, they shall be repaired so as to make their operation equal to that before the trenching was started at no additional cost to owner

F. Where the excavation requires the opening of existing walks, drives, or other existing pavement, these facilities shall be cut as required to install new lines and to make connections to existing lines. The sizes of the cut shall be held to a minimum consistent with the work to be installed. After installation of new work is completed and the excavation has been backfilled in accordance with above, repair existing walks, drives or other existing pavement to match existing installation

G. Use the size and types of conduit as indicated on the Drawings for the various duct banks required for the project

H. Make duct bank installations and penetrations through foundation walls watertight

I. Assemble ductbanks using non-magnetic saddles, spacers, and separators. Position separators to provide 3-inch minimum concrete separation between the outer surfaces of the conduits

J. Provide a 3-inch minimum concrete covering on both sides, top and bottom of concrete envelopes around conduits. Add red dye at the rate of 10 pounds per cubic yard to concrete used for envelopes for easy identification during subsequent excavation

K. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to ensure filling of spaces between ducts

L. Make bends with sweeps of radius not less than 6 times the smallest diameter of the raceway

M. Make a transition from non-metallic to metallic rigid conduit where duct banks enter structures or turn upward for continuation above grade

N. Make bends of 30 degrees or more using rigid galvanized steel

O. Reinforce duct banks throughout, where indicated on the Drawings

1. Unless otherwise noted on the Drawings, reinforce with No. 5 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 12 inches on centers, and No. 5 tie-bars transversely placed at 18-inch maximum longitudinal intervals

2. Maintain a maximum clearance of 3 inches from bars to the edge of the concrete encasement

P. Where ducts enter structures such as handholes, manholes, pull boxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Myers hubs or couplings on steel conduits. Tag conduit entering pull boxes with stamped, stainless steel tags. Identify as designated in cable and conduit schedule

Q. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials that can damage or contribute to corrosion of ducts or prevent adequate compaction of fill

R. Install a bare stranded copper duct bank ground on top of duct bank. Make ground electrically continuous throughout the entire duct bank system. Connect ground to switchgear and MCC ground buses and to steel conduit extensions of the underground duct system

S. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately one-fourth inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to remove any particles of earth, sand or gravel that may have been left in the duct. Re-pull the rag or sponge swab until the swab emerges clean

T. Use hemp rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose

U. Install a warning ribbon approximately 12 inches below finished grade over underground duct banks.

V. For manholes and pull boxes below grade, install racks to support cables properly around the perimeter and keep them dry. Arrange cables in orderly fashion and tie to racks. If metallic racks are used, provide grounding per NEC

W. For manholes and pull boxes below grade, construct a french drain, or other drainage as detailed on the Drawings

X. All manhole and U.G. pull boxes used for electrical construction are to have the work “Electrical” permanently embossed on cover

Y. Conduits penetrating underground pull boxes shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon-based sealant where smaller than 1 ½-inch diameter

Z. Conduits penetrating structural walls of lower levels shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon-based sealant where smaller than 1 ½-inch diameter

AA. All conduit duct banks penetrating lower level structures and penetrating underground pull boxes shall be sealed watertight between conduit and wall of structure or pull box

BB. Install identification tags on all conduits at manholes, pull boxes, and junction boxes

CC. Conduits shall be separated by means of manufactured interlocking “chairs” spaced at no more than 5 feet apart along the length of the ductbank. Spacing between conduits shall not be less than 3 inches

DD. Every effort shall be made to minimize the number of bends in all ductbank systems. Field bends shall be made using a “hot box” designed for the size of PVC used. Care shall be given to ductbank routing so that very large radius sweeping turns are designed into the route as opposed to factory made 45° and 90° bends. When factory 90° bends are used, they shall be a minimum of 36-inch radius for 4 inch and 48-inch radius for 5 inches. Factory 90° bends used in ductbank construction shall be rigid metal conduit (ferrous) only. These factory-made bends shall be protected by corrosion tape such as 3M Scotchrap 50 or approved equal prior to the concrete pour

EE. The ductbank support “chairs” shall be spaced up from the bottom of the trench using cement brick to ensure that the proper amount of concrete is poured under the conduits. Sides of the trench may be used as the form if the width does not exceed 1 ½ times the recommended dimension of the ductbank (width.)

FF. The Electrician shall vacuum, swab, and install pull strings in every conduit of the completed ductbank. The pull string shall be permanently marked in 1-foot increments to aid in wire estimation on future projects. Use Greenlee #435 pull string or approved equal

GG. Route all electrical ductbanks and conduits below water lines. Maintain minimum of 24 inches between bottom of water line and top of ductbank

HH. Electrical ductbanks are not required below concrete floors of buildings or below process equipment slabs, at which locations conduits shall be encased in minimum 3 inches of stabilized sand. Where ductbanks are shown on plans to be routed under existing concrete slabs or pavements, install per plan details. Do not cut rebar in existing conduit except where approved by Engineer. Repair any cut or damaged rebar by welding back together after conduits are installed. Submit detail of intent for cutting or removal of existing concrete for ductbank installation to Engineer for approval

END OF SECTION

Section 16211

Electrical Utility Service

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. Electric Utility Charges: Electric Utility charges for extension of distribution system to point of service termination and meters will be paid by Owner, except where bid allowance is indicated, or where specifically noted otherwise on plans or in other specifications

D. Temporary service disconnects at existing installations shall be paid for by Contractor. Prompt connection or reconnection of service shall be coordinated by Contractor. All temporary disconnection and reconnection costs are to be paid for by Contractor

E. Determine the exact requirements for the utility service connections and metering facilities as set forth by the utilities that will serve the project, and pay for and perform all work as required by those utilities

1.02 PRICE AND PAYMENT PROCEDURES

A. The Contractor shall request and pay for the service installation as part of this Contract and maintain the electrical service until the facility is fully installed and accepted by the Engineer and Owner

B. Allowance may be shown on bid sheet. Where not shown, contractor shall include all costs required for new service or modification to existing service

1.03 REFERENCES

A. National Fire Protection Association (NFPA): NFPA No. 7093 National Electrical Code (NEC)

B. Installation shall strictly comply with current Power Company standards. Where plans conflict with Power Company standards, contact Engineer for directions before starting work. Failure to do so is at Contractor’s risk

1.04 ADMINISTRATIVE REQUIREMENTS

A. The Contractor shall be required to transfer ownership of the electric service to the Owner. Documentation of the transfer of ownership shall be submitted to the

Owner prior to Contract Closeout. Final payment will not be released until transfer of ownership documents have been submitted to the Owner

PART 2. PRODUCTS

2.01 ELECTRIC SERVICE

A. Electric Service Characteristics:

1. As indicated on Drawings and provided by Electric Utility. Standard voltage is as follows:
    a. 480/277-volt, 3 phase, 4 wire
    b. 120/240-volt, 3 phase 4 wire
    c. 120/240-volt, single phase, 3 wire
    d. Or as shown otherwise
2. Where 480-volt delta service is specifically shown on plans, adjust electrical wiring and select all devices to accommodate that type service. Where 12,470-volt primary service is provided, select all devices to accommodate that type service
3. All 480/277-volt service 200 amps and under, where the service conductors' feeds through the meter shall have a disconnect switch installed upstream of the meter per Power Company standards. This requirement is essential and may be shown on plans. CT cans are required for service above 200 amp
4. Allow for aerial or underground service equipment in bid as determined by Power Company. Most stringent requirements shall be provided at no additional cost to Owner
5. Do not route aerial service drop across site. Contact Engineer if problem.

B. Service Pole Location: Locate service pole based on "Outlet Location Data Statement" and drawing from Power Company. Do not install service pole or service equipment without this data statement and without confirming location with Power Company and Engineer. Contact Engineer prior to construction. Provide submittal with layout of Power Company's pole, Owner's service pole or rack, control panel or MCC or control building for review by owner, Engineer and Power Company before starting construction. Send copy of Power Company "Outlet Location Data Statement" to Engineer for review. Any construction performed without Engineer's review is at Contractor's risk and expense

C. All bus weatherhead installations shall have approved insulated split closure plate around entering conductors from Power Company drop to prevent entry of birds or animals into bus weather head assembly. Install EYS seals in conduits from weather head above to equipment below.

D. Provide pad mounted transformer service equipment, conduits and devices where only U.G. or pad mounted transformer service is available from Power Company

PART 3. EXECUTION

3.01 PREPERATION

A. Confirmation of Electric Service:

1. Consult with Electric Utility to verify service information specified and shown on Drawings. Failure to do so may result in removal and replacement of service equipment at Contractor's cost. Do not start service installation work until "Outlet Location Data Statement" has been received from Power Company and has been reviewed and approved in writing by the Engineer

B. Include deviations required by Electric Utility from contract documents to comply with Electric Utility standards and requirements. Send drawing of final service arrangement for engineer's review. Do not install service equipment until approved by Power Company in writing

C. Relocate service pole, transformer pad or structure up to (10) ten feet to maintain clearance required by Electric Utility Company or to maintain other clearances. Coordinate exact point of service with Power Company and locate customer service pole within distance of Power Company pole as per Power Company Standards. Failure to coordinate location is at expense of Contractor and at no additional cost to Owner

D. Metering:

1. Consult with Electric Utility regarding service entrance requirements and metering equipment. Conform strictly to Utility Company standards

2. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility

3. Consult with electric utility regarding arrangement of disconnect switch in relation to meter, meter can, or other service equipment

4. Where 480 voltmeters is used and a manual transfer switch is used, install one (1) disconnect switch above meter and one (1) below meter per Power Company requirements

E. Application for Electric Service.

1. Obtain required forms from Electric Utility.

2. Assist Owner in completion of forms and deliver completed forms to Electric Utility. Advise Owner of exact voltage and phase requirements

3. Coordinate schedule for installation of electric service with Electric Utility.

4. Notify utility company in writing, within 30 days of project start date that permanent service will be required for this project. Specify date required and location of project

5. Notify Owner and Engineer, in writing of date service applied for, date to be installed, Power Company contact name and telephone number and copy of

"Outlet Location Data" report as this information become available. Do not start construction of service without this report and without confirming service location with Engineer

6. Notify Power Company when old abandoned service is to be disconnected. Coordinate with Owner
7. Contractor is responsible to see that service is connected according to the Power Company standards. Final permanent service connection by Power Company is required before project is considered complete, before final acceptance, and before final payment is made

END OF SECTION

Section 16410

Enclosed Switches and Circuit Breakers

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. This section covers service disconnects, feeder disconnects, equipment disconnects, and enclosed circuit breakers

1.02 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

B. Product Data:

1. Submit for switches, circuit breakers, and accessories
2. Descriptive data and time current curves for protective devices and let through current curves for those devices with current limiting characteristics. Include coordination charts and tables, and related data

1.03 RECORD DRAWINGS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.04 OPERATIONS & MAINTENANCE MANUALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.05 QUALITY ASSURANCE

A. Coordination: Contractor shall determine size, horsepower, voltage, and phase of all equipment to provide/adjust breaker and fused switch size accordingly. Failure to do so will be at expense of contractor at no additional cost to owner

PART 2. PRODUCTS

2.01 MANUFACTURER'S

A. Fusible Switches:

1. Eaton
2. Or approved equal

B. Fused Power Circuit Devices:

1. Eaton
2. Or approved equal

C. Boltswitch

D. Molded Case Circuit Breakers:

1. Eaton
2. Or approved equal

E. Combination Circuit Breaker and Ground Fault Trip:

1. Eaton

F. Molded Case Current Limiting Circuit Breakers:

1. Eaton

2.02 ENCLOSED SWITCHES

A. Enclosed Non-fusible Switch: NEMA KS 1, Type HD handle lockable with 2 padlocks

B. Enclosed Fusible Switch, 800 Amperes and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with two (2) padlocks, and interlocked with cover in CLOSED position

C. Enclosed Fusible Switch Larger Than 800 Amperes: Bolted pressure or high-pressure contact switch, bus drilled to accommodate specified fuses, enclosure consistent with environment where located

1. Minimum Fault Current Rating: 100,000 symmetrical rms amperes.

D. All enclosures located outdoors or where subject to wet or environmentally harsh locations shall be NEMA 4X 316 stainless steel

E. All switches shall be rated at 600 volts minimum.

F. Handle operator mechanisms shall be on side of enclosure and not on front. Keyed mechanisms that separate handle from breaker mechanism when door is opened are not acceptable

2.03 ENCLOSED CIRCUIT BREAKERS

A. Enclosed Molded Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks

B. Characteristics:

1. Frame size, trip rating, number of poles, and auxiliary devices as indicated
2. Interrupting capacity rating to meet available fault current, 10,000 symmetrical rms amperes minimum

3. Appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment

C. All enclosures located outdoors or where subject to wet or environmentally harsh locations shall be NEMA 4X 316 stainless steel

2.04 ACCESSORIES

A. Solid state breaker requiring programming unit for settings adjustment

1. Provide new programming unit and all accessories for Owner and Engineers use. Turn over to Engineer for review and testing

B. Original set-up and adjustments shall be performed by the Circuit Breaker Manufacturers Factory Representative

2.05 TRIP UNITS

A. All service and feeder breakers shall have replaceable trip plugs, adjustable, or electric type with adjustable trips

PART 3. EXECUTION

3.01 INSTALLATION

A. Install enclosed switches and circuit breakers in locations as indicated, according to Manufacturer's written instructions

B. Install enclosed switches and circuit breakers level and plumb

C. Install wiring between enclosed switches and circuit breakers and control/indication devices

D. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A

3.02 ADJUSTEMENT/CALIBRATION

A. Set field adjustable enclosed equipment trip ranges as recommended by manufacturer

END OF SECTION

Section 16415

Surge Suppression

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid

C. This section describes the requirements for low-voltage AC surge protective devices (SPD's) for various service and electrical equipment

D. All equipment described herein shall be submitted, and factory installed, as an integral part of equipment specified in overall construction documents

1.02 PRICE AND PAYMENT PROCEDURES

A. No separate payment for work performed under this section. Include cost for surge suppression in overall electrical equipment

1.03 REFERENCES

A. This specification references the following publications in their current editions. The publications are referred to in the text by basic designation only

1. DLA MIL-STD-220C: Method of Insertion Loss Measurement
2. IEEE C37.90.1: Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
3. IEEE C62.41.2: Recommended Practice on Characterization of Surges in Low Voltage (1,000 V and Less) AC Power Circuits
4. IEEE C62.45: Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits
5. NFPA 70: National Electrical Code (NEC) - Article 285 UL 67: UL Standard for Safety Panelboards
6. UL 845: UL Standard for Safety Motor Control Centers UL 891: UL Standard for Safety Switchboards
7. UL 1283: UL Standard for Safety Electromagnetic Interference Filters
8. UL 1449: UL Standard for Safety Surge Protective Devices
9. UL 1558: UL Standard for Safety Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
10. UL 67: UL Standard for Safety Panelboards

11. UL 845: UL Standard for Safety Motor Control Centers
12. UL 891: UL Standard for Safety Switchboards
13. UL 1558: UL Standard for Safety Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
14. All SPDs and their installation shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable
15. Each specified device shall also conform to the standards and codes listed in overall construction documents
16. Refer to general work and all relevant specifications in construction documents for additional requirements and coordination
17. Refer to submittal requirements in other specifications for full requirements
18. Refer to O&M manual requirements in other specifications for full requirements

1.04 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

B. Submit catalog data for all items supplied from this section as applicable. Submittal shall include at minimum:

1. Cut sheets
2. Functions
3. Ratings
4. Inputs
5. Outputs
6. Displays
7. Dimensional drawings of each SPD type
8. UL 1449 documentation
9. Compliance documentation with Nationally Recognized Testing Laboratory (NRTL)
10. UL 1283 documentation
11. IEEE C62.41.2 and IEEE C62.45, Category C3 (20kV-1.2/50, 10kA-8/20µs waveform) clamping voltage test results
12. All other information required to confirm SPD conforms to all requirements

1.05 OPERATIONS & MAINTENANCE MANUALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.06 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar equipment for a minimum of five (5) years. Engineer may request a list of installations with similar equipment demonstrating qualifications

B. The manufacturer shall be the same manufacturer providing service entrance and distribution equipment where SPD's are to be installed

C. Equipment shall comply and be tested under the UL standards stated in reference section of this specification

D. Manufacturer shall be ISO 9001 or 9002 certified

1.07 SPARE PARTS

A. Provide one surge protective device per installed equipment on project

B. Deliver spare parts to operations and provide signed transmittal form to engineer

C. Lack of transmittal form may require providing additional equipment at no additional cost to owner where supply chain is broken

PART 2. PRODUCTS

2.01 APPROVED SPD TYPE 1 AND TYPE 2 MANUFACTURER'S

A. Eaton

B. General Electric

C. Schneider Electric

D. Allen Bradley

E. Citel

F. Or approved equal

2.02 APPROVED SPD TYPE 3 MANUFACTURER'S

A. EDCO SLAC Series

B. Phoenix Contact

C. Citel

D. Siemens

E. Or approved equal

2.03 SERVICE ENTRANCE RATED EQUIPMENT (TYPE 1)

A. This type applies to switchgear, switchboards, panelboards, motor control centers, and other devices installed as service entrance equipment

B. Where a type 1 SPD installed on service entrance equipment, an additional type 2 SPD shall not be installed unless shown on plans

C. The SPD shall be of the same manufacturer as the electrical equipment installed

D. The SPD shall be integral to the equipment as a factory standardized design

2.04 DISTRIBUTION EQUIPMENT APPLICATIONS (TYPE 2)

A. This type applies to switchgear, switchboards, panelboards, motor control centers, and other devices installed as non-service entrance equipment

B. The SPD shall be of the same manufacturer as the electrical equipment installed

C. The SPD shall be integral to the equipment as a factory standardized design

D. The SPD shall be included and mounted within the equipment by the equipment manufacturer

E. The SPD shall be located within the panelboard, unless otherwise noted in plans

2.05 CONSTRUCTION

A. Overcurrent Protection: The unit shall contain thermally protected metal-oxide varistors (MOVs). The thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOVs from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

B. Maintenance Free Design: The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries are not acceptable. SPDs requiring any maintenance of any sort such as periodic tightening of connections are not acceptable.

C. Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules are not acceptable.

D. Electrical Noise Filter: Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the DLA MIL-STD-220C insertion loss test method.

E. Local Monitoring: Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.

F. Surge Counter: The SPD shall indicate user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. To prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total. The ongoing surge count shall be stored in nonvolatile memory or UPS backup.

G. Remote Monitoring: For remote monitoring, the SPDs shall provide the same discrete and analog signal and control functions as specified for local monitoring and the surge counter, to a terminal strip for outgoing connection to a PLC as shown on the Plans. The functions shall be converted as specified for interface to the monitored equipment.

H. The voltage surge suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

I. SPD shall be listed in accordance with UL 1449 and UL 1283

J. Integrated surge protective devices (SPD) shall be Component Recognized in accordance with UL 1449, Section 37.3.2 and 37.4 at the standard's highest short circuit current rating (SCCR) of 200 kA, including intermediate level of fault current testing.

K. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50µs, 10kA-8/20µs).

L. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems (7 Mode).

2.06 RATINGS

A. Unit operating voltage: Refer to plans for operating voltage equipment and unit configuration

B. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage measured on site

C. Minimum surge current rating shall be 240kA per phase (120kA per mode) for service entrance and 120kA per phase (60kA per mode) for distribution applications

D. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE category C high transients without failure or degradation of clamping voltage by more than 10%

E. Minimum UL 1449 withstand nominal discharge current (In) rating to be 20kA per mode

F. UL 1449 clamping voltage must not exceed the following: Voltage Protection Rating (VPR)

Voltage	L-N	L-G	N-G
204/120	1200/800V	800V	800V
208Y/120	800V	800V	800V
480Y/277	1200V	1200V	1200V
600Y/347	1500V	1500V	1500V

PART 3. EXECUTION

3.01 INSTALLATION

A. All equipment specified herein shall be factory installed, field adjusted, tested, and cleaned as an integral part of equipment specified in other equipment specification

B. Type 1 and 2 SPD's shall be grounded and bonded as a part of the individual equipment as specified in the individual equipment specifications

C. Type 3 shall be grounded and bonded in accordance with the SPD manufacturer's instructions

D. All monitoring and diagnostic features shall be visible from the front of the equipment

E. Provide and install a fully integrated component design: All SPD's components and diagnostics shall be contained within one discrete assembly

F. SPD's or individual SPD modules that must be ganged together to achieve higher surge current ratings

G. Furnish nameplates for each SPD as shown on plans

3.02 SERVICE ENTRANCE RATED EQUIPMENT (TYPE 1)

A. Service entrance located SPD's shall be tested and demonstrate suitability for application within IEEE C26.41.2 category C environments

B. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bars

C. The SPD shall be connected through a UL approved disconnecting means. The disconnect shall be located in immediate proximity to the SPD

D. Connection shall be made via electrical bus, conductors, or other connections originating in the SPD and shall be kept as short as possible

3.03 DISTRIBUTION EQUIPMENT APPLICATIONS (TYPE 2)

A. Service entrance located SPD's shall be tested and demonstrate suitability for application within IEEE C26.41.2 category B environments

B. SPD's shall be installed immediately following the load side of the main breaker

C. SPD's installed in main lug only panelboards shall be installed immediately following the incoming main lugs

3.04 INDIVIDUAL EQUIPMENT PROTECTION (TYPE 3)

A. Locate the SPD on the load side of the ground and neutral connections

B. The SPD shall be connected through a UL approved disconnecting means. The disconnect shall be located in immediate proximity to the SPD

3.05 ADJUSTEMENT/CALIBRATION

A. Coordinate stabilized voltage levels within the project boundaries and provide product voltage rated equipment appropriate to avoid overvoltage

3.06 MAINTENANCE/WARRANTY

A. The manufacturer shall warrant the equipment to be free from defects in material and workmanship for ten (10) years from date of substantial completion

B. Within such period of warranty, the manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition

C. Any warranty work requiring shipping or transporting of the equipment shall be performed by the manufacturer at no expense to owner

END OF SECTION

SECTION 16510

INTERIOR LIGHTING

PART 1 GENERAL

1.00 SUMMARY

A. Section Includes:

1. This section specifies the furnishing, installation, and connection of the interior lighting systems.

1.01 REFERENCES

A. Illuminating Engineering Society of North America (IESNA)

1. LM-79 – Electrical and Photometric Measurements of Solid-State Lighting Products.
2. LM-80 – Measuring Lumen Maintenance of LED Light Sources.
3. LM-82 – Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature.

B. Institute of Electrical and Electronic Engineers, Inc. (IEEE)

1. C62.41 – Surge Voltages in Low-Voltage AC Power Circuits

C. National Electrical Manufacturers Association (NEMA)

1. C82.4 – High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps
2. C78.x Series – American National Standards for Lamps
3. SSL 1-16 – Electronic Drivers for LED Devices, Arrays, or Systems

D. Underwriters Laboratories (UL)

1. 486A-486B – Wire Connectors
2. 496 – Lampholders
3. 844 – Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
4. 1029 – High-Intensity-Discharge Lamp Ballasts
5. 1570 – Fluorescent Lighting Fixtures
6. 8750 – Light Emitting Diode (LED) Light Sources for use in Lighting Products

E. National Fire Protection Association (NFPA)

1. NFPA 70 – National Electric Code (NEC)

a. Article 410 - Lighting Fixtures, Lampholders, Lamps and Receptacles

1.02 SUBMITTALS

A. Product Data

1. Submit the following for Engineer's approval:

a. Manufacturer's cut sheets, catalog data, with selected products clearly marked.

b. Include data on features and accessories and following:

(i) Outline drawings indicating dimensions and principal features of fixtures.

(ii) Electrical Ratings and Photometric Data.

(iii) Air and thermal performance data for air-handling fixtures.

c. Instructions for installation.

d. Dimensions and weight.

e. Schedule of features, characteristics, ratings, and factory settings of individual devices.

B. Shop Drawings

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Test and Evaluation Results

1. Certification by the Contractor that the interior lighting systems have been properly installed and tested.

D. Operation and Maintenance Data

1.03 QUALITY ASSURANCE

A. General

1. Provide luminaires from a single manufacturer for each luminaire type.

2. Fixtures for Hazardous Locations: Conform to UL 844. Provide units that have Factory

Mutual Engineering and Research Corporation (FM) certification for indicated class and division of hazard.

3. Coordinate fixtures, mounting hardware, and trim with ceiling system and other items, including work of other trades, required to be mounted on ceiling or in ceiling space. Provide only fixtures that fit ceiling construction.

4. Special Listing and Labeling: Provide fixtures for use in damp or wet locations, underwater, and recessed in combustible construction that are specifically listed and labeled for such use. Provide fixtures for use in hazardous (classified) locations that are listed and labeled for specific hazard.

B. Manufacturer Qualifications

1. Lighting fixtures shall be of specification grade and listed or labeled by Underwriters Laboratories (UL) or an approved Nationally Recognized Testing Laboratory (NRTL).

C. Certifications

1. All electrical work shall be performed only by a Texas State Licensed Electrical Contractor

D. Regulatory Requirements

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements

1. Deliver products to site in acceptable condition and in protective wrappings.

2. Store and protect products from damage.

3. Accept products on site in factory containers and verify damage.

4. Store products in clean, dry area.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. As shown on plans.

2.02 FIXTURE AND COMPONENTS

A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.

B. Provide lighting fixtures in accordance with the lighting plan Drawings, Lighting Fixture Schedules and this specification.

C. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.

D. 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.

E. Metal Parts:

1. Sheet metal components shall be steel unless otherwise indicated and shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.

2. Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.

3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.

4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

F. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.

G. Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:

1. White Surfaces: 85%.

2. Specular Surfaces: 83%.

3. Diffusing Specular Surfaces: 75%.

4. Laminated Silver Metallized Film: 90%.

H. Diffusers and Globes:

1. Prismatic acrylic

2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

3. Glass: Annealed crystal glass unless otherwise indicated.

4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

I. Fixture Support Components:

1. Comply with requirements in Section 16070 - "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

2. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy.

Finish same as luminaire.

3. Rod Hangers: 3/16-inch minimum diameter, stainless steel threaded rod.

4. Stainless Steel Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

J. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

K. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

L. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

2.03 FINISHES

A. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.

B. Interior light reflecting finishes shall be white with not less than 85 percent reflectance, except where otherwise shown on the drawing.

C. Exterior finishes shall be as shown on the drawings.

2.04 LED LIGHT FIXTURES

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.

2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.

3. LED drivers shall include the following features unless otherwise indicated:

a. Minimum efficiency: 85% at full load.

b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)

c. Input Voltage: 120 - 277V (±10%) at 60 Hz unless otherwise indicated. Refer to lighting fixture schedule on plan set.

d. Integral short circuit, open circuit, and overload protection.

e. Power Factor: ≥ 0.95.

f. Total Harmonic Distortion: ≤ 20%.

g. Comply with FCC 47 CFR Part 15.

4. LED modules shall include the following features unless otherwise indicated:

a. Comply with IES LM-79 and LM-80 requirements.

b. Minimum CRI 80 and color temperature 4000˚ K unless otherwise indicated. Refer to lighting fixture schedule on plan set.

c. Minimum Rated Life: 50,000 hours per IES L70.

B. LED Downlights:

1. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. LED Troffers:

1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.

2. Housing, LED driver, and LED module shall be products of the same manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's written instructions and approved Shop Drawings.

B. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.

C. Bond lighting fixtures to the grounding system as specified in Section 16060 – “Grounding and Bonding for Electrical Systems.”

3.03 CONNECTIONS

A. Ground lighting units. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.04 FIELD QUALITY CONTROL / TESTING

A. Inspect each installed fixture for damage. Replaced damaged fixtures and components.

1. Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source.

2. Give advance notice of dates and times for field tests.

3. Provide instruments to make and record test results.

B. Replace fixtures that show evidence of corrosion during Project warranty period.

3.05 ADJUSTING AND CLEANING

A. Clean fixtures after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

SECTION 16520

EXTERIOR LIGHTING

PART 1 GENERAL

1.00 CONDITIONS

A. Installation and materials shall comply with local ordinances and illumination requirements.

1.01 SUMMARY

A. Section Includes:

1. Exterior lighting fixtures, lamps, poles standards, and accessories.

B. Definitions:

1. Fixture: Complete lighting unit. Fixtures include lamp or lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply.

2. Lighting Unit: Fixture, or assembly of fixtures with common support, including pole or bracket plus mounting and support accessories.

3. Luminaire: Fixture.

1.02 REFERENCES

A. Illuminating Engineering Society of North America (IESNA)

1. LM-79 – Electrical and Photometric Measurements of Solid-State Lighting Products.

2. LM-80 – Measuring Lumen Maintenance of LED Light Sources.

3. LM-82 – Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature.

B. American National Standards Institute (ANSI):

1. C78.1 to C78.1502 – Electric Lamps.

2. C136.13 – Roadway Lighting - Metal Brackets for Wood Poles.

3. C136.30 – Roadway Lighting Equipment

4. C05.1 – Wood Poles

C. American Society for Testing and Materials (ASTM)

1. A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel

Structural Tubing in Rounds and Shapes.

2. B209 – Standard Specifications for Aluminum and Aluminum-Alloy Sheet and Plate.

3. B429 – Standard Specifications for Aluminum-Alloy Extruded Structural Pipe and Tube.

D. Institute of Electrical and Electronic Engineers, Inc. (IEEE)

1. C62.41 – Surge Voltages in Low-Voltage AC Power Circuits

E. National Electrical Manufacturers Association (NEMA)

1. C78.x Series – American National Standards for Lamps- exact section as determined by lamp type

2. SSL 1-16 – Electronic Drivers for LED Devices, Arrays, or Systems

F. Underwriters Laboratories (UL)

1. 486A-486B – Wire Connectors

2. 496 – Lampholders

3. 773 – Safety Plug-In, Locking Type Photocontrols for Use with Area Lighting.

4. 844 – Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

5. 1029 – High-Intensity-Discharge Lamp Ballasts

6. 1570 – Fluorescent Lighting Fixtures

7. 8750 – Light Emitting Diode (LED) Light Sources for use in Lighting Products

G. National Fire Protection Association (NFPA)

1. NFPA 70 – National Electric Code (NEC)

H. Federal Aviation Administration (FAA)

1. AC 70/7460-1 Obstruction Marking and Lighting

2. AC 150/5345-43 Specification for Obstruction Lighting Equipment.

1.03 SUBMITTALS

A. Product Data

1. Submit the following for Engineer’s approval:

a. Manufacturer's cut sheets, catalog data, with selected products clearly marked.

b. Instructions for installation.

c. Dimensions and weight.

d. Include data on features, poles, accessories, and following:

(i) Outline drawings of fixtures and poles indicating dimensions and principal features.

(ii) Electrical ratings and photometric data with certified results of independent laboratory tests.

B. Shop Drawings

1. Detail fixtures and poles and indicating dimensions, weights, methods at field assembly, components, and accessories.

C. Test and Evaluation Results

1. Certified reports of field tests and observations.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Firms experienced in manufacturing lighting units that are similar to those indicated for this Project and that have record of successful in service performance.

B. Regulatory Requirements

1. Fixtures for Hazardous Locations: Conform to UL 844 or get Factory Mutual Engineering and Research Corporation (FM) certification for the class and division of hazard.

2. Fixtures for Aircraft Obstruction Lighting: Provide FAA approved lighting fixtures for Obstruction Lighting.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements

1. Deliver products to site in acceptable condition and in protective wrappings.

2. Store poles on decay-resistant treated skids at least 1 ft above grade and vegetation. Support pole to prevent distortion and arrange to provide free air circulation.

3. Retain factory-applied pole wrappings until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

4. Accept products on site in factory containers and verify damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. As shown on plans.

2.02 FIXTURE COMPONENTS, GENERAL

A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.

B. Provide lighting fixtures in accordance with the lighting plan Drawings, Lighting Fixture Schedules and this specification.

C. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.

D. 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.

E. Metal Parts:

1. Sheet metal components shall be steel unless otherwise indicated and shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.

2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.

3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.

4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

F. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.

G. Exposed Hardware Material: Stainless steel.

H. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor mounting in fixture doors.

I. Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:

1. White Surfaces: 85%.

2. Specular Surfaces: 83%.

3. Diffusing Specular Surfaces: 75%.

J. Photoelectric Relay: UL 773.

1. Contact Relays: Single-throw, arranged to fail in the "on" position and factory set to turn light unit on at 1.5 to 3 foot-candles and off at 4.5 to 10 foot-candles with 15 sec' minimum time delay.

2. Relay Mounting: In fixture housing.

K. Fixture Support Components:

1. Comply with requirements in Section 16070 - "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

2. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

3. Rod Hangers: 3/16-inch minimum diameter, stainless steel threaded rod.

4. Stainless Steel Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

L. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

2.03 PHOTO CELLS

A. Provide a photo cell to control outdoor fixtures unless otherwise indicated on the lighting plans.

B. Use a photo cell that is either the plug-in twist-locking type or the wire-in swivel-top type, both with similar features and operating characteristics.

C. Provide a photo cell that is enclosed in a UV-resistant rain-tight polypropylene housing with the cell being a 0.75 square inch cadmium sulfide surface passivated and a single pole, single throw normally closed bi-metallic switch

2.04 LED LIGHTING FIXTURES

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.

2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.

3. LED drivers shall include the following features unless otherwise indicated:

a. Minimum efficiency: 85% at full load.

b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)

c. Input Voltage: 120 - 277V (±10%) at 60 Hz unless otherwise indicated. Refer to lighting fixture schedule on plan set.

d. Integral short circuit, open circuit, and overload protection.

e. Power Factor: ≥ 0.95.

f. Total Harmonic Distortion: ≤ 20%.

g. Comply with FCC 47 CFR Part 15.

4. LED modules shall include the following features unless otherwise indicated:

a. Comply with IES LM-79 and LM-80 requirements.

b. Minimum CRI 80 and color temperature 4000˚ K unless otherwise indicated. Refer to lighting fixture schedule on plan set.

c. Minimum Rated Life: 50,000 hours per IES L70.

B. For outdoor application the fixtures shall be of vaporproof NEMA 4X construction with globe, guard and stainless steel hardware.

2.05 FIXTURE SUPPORT COMPONENTS

A. Pole-Mounted Fixtures:

1. Conform to AASHTO LTS 1.

B. Wind-Load Strength:

1. 100 mph and 1.3 gust factor for total support assembly, including pole, base, and anchorage, where used, to carry fixtures, supports, and appurtenances at indicated heights above grade without deflection or whipping. Should local Codes dictate higher wind rating, most stringent rating shall apply.

C. Arm, Bracket, and Tenon Mount Materials:

1. Match the poles.

D. Mountings, Fastenings, and Appurtenances:

1. Corrosion-resistant components compatible with poles and fixtures that will not cause galvanic action at contact points. Provide mountings that will correctly position luminaire to provide indicated light distribution.

E. Pole Shafts:

1. As shown on Plans.

F. Pole Bases:

1. Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts, and bolt covers.

G. Anchor Bolts:

1. Anchor bolt length, orientation, and thread projection shall comply with pole manufacturer recommendations. Plywood (or equal) template shall be used during placement of anchor bolts for correct pole base hole alignment. Finished bolt alignment shall be straight and true.

H. Steel Poles:

1. Steel tubing conforming to ASTM A500, Grade B, carbon steel with minimum yield of 46,000 psi. Poles are 1 piece construction up to 40 ft in length and have access handhole in wall.

I. Steel Mast Arms:

1. Fabricated from 2 in. pipe, continuously welded to pole attachment plate and having span and rise as indicated.

J. Metal Pole Brackets:

1. Designed to match pole metal. Provide cantilever brackets without underbrace, in the sizes and styles indicated, with straight tubular end section to accommodate the fixture.

K. Pole-Top Tenons:

1. Fabricated to support fixture indicated and securely fastened to the pole top.

L. Metal Pole Grounding Provisions:

1. Welded 1/2 in. threaded lug, accessible through handhole.

2.06 LAMPS

A. Conform to ANSI Standards, C78 series, applicable to each type of lamp. Provide fixtures with indicated lamps. Where lamps are not indicated, provide lamps recommended by manufacturer.

2.07 FINISH

A. Metal Parts:

1. Manufacturer's standard finish except as otherwise indicated. Finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and similar defects. Remove poles, fixtures, and accessories showing evidence of corrosion or finish failure during Project warranty period and replace with new items.

B. Other Parts:

1. Manufacturer's standard finish except as otherwise indicated.

2.08 AIRCRAFT OBSTRUCTION LIGHTING

A. Match all characteristics defined for the lighting fixture type as specified by AC 150/3545-43J.

B. For structures 150 ft or less: provide Double L-810 type steading steady burning aviation red lighting fixtures for obstruction light mounted on the highest part of the structure.

C. For structures 150ft to 350ft provide:

1. L-864 type flashing aviation red lighting fixture at the highest part of the structure.

2. Flashing Aircraft Obstruction Lights shall meet the following provisions:

a. A control unit to set the system flash rate (30 Hz) and flash sequence.

b. Failure of the control unit shall result in steady burning of the light fixture(s).

c. A manual override switch mounted to the control unit to manually operate the light during maintenance.

d. Flashing lights must be certified with their control unit.

e. All flashing lights must flash in unison.

3. 4 or more L-810 F flashing lights at intermediate levels mounted such that there is an unobstructed view of at least one light from any direction.

PART 3 EXECUTION

3.01 INSTALLATION

A. Set units plumb, square, level, and secure according to manufacturer's written instructions and approved submittals.

B. Aircraft Obstruction mounting for L-810 and L-810 F fixture shall be either ¾ in or 1 in NPT on the side or bottom of the lighting unit.

3.02 CONCRETE FOUNDATIONS

A. Construct concrete foundations with 3,000 psi, 28 day concrete. Foundations shall be sized by Pole/Lighting Manufacturer and designed for 110 mph winds. Dimension and depth shall

be per Manufacturer's recommendations. Use Manufacturer's template for setting factory anchor bolts.

B. Embedded Poles: Set poles to indicated depth, but not less than 1/6 of pole length below finish grade. Dig holes large enough to permit use of tampers full depth of hole. Backfill in 6 in. layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

C. Pole Installation: Use fabric web slings (not chain or cable) to raise and set poles.

D. Fixture Attachment: Fasten to indicated structural supports.

E. Fixture Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution.

F. Lamp fixtures with indicated lamps according to manufacturer's instructions. Replace malfunctioning lamps.

3.03 GROUNDING

A. Poles: Install 10 ft driven ground rod in ground well at each pole. Solidly connect ground rod to ground lug in metallic poles.

B. Nonmetallic Poles: Ground metallic components of lighting unit and foundations. Connect fixtures to grounding system with No. 6 AWG conductor.

3.04 FIELD QUALITY CONTROL

A. Inspect installed units for damage.

B. Provide advance notice of dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: Verify normal operation of lighting units after installing fixtures and energizing circuits with normal power source. Include the following:

1. Photometric Tests: Measure light intensities at locations where specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.

2. Check for excessively noisy ballasts.

3. Check for uniformity of illuminations.

4. Written report of tests indicating actual illumination results.

E. Replace or repair damaged and malfunctioning units and retest.

3.05 ADJUSTING AND CLEANING

A. Clean components on completion of installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

Section 16940

Instrumentation Heat Trace System

PART 1. GENERAL

1.01 SUMMARY

A. Furnish and install thermostatically controlled heat trace system for freeze protection.

B. The system shall include controls, control cabinet, cable, insulation and jacket as indicated on the Contract Drawings and as specified hereinafter.

C. Furnish and install all weather-tight LB fittings, liquid-tight connectors, liquid-tight flexible metal conduit and wiring, etc, to provide power and controls for a complete operating system.

D. Items to be protected by heat trace include:

1.02 SUBMITTALS

A. Heat Trace Cable.

B. Heat Trace Cable Insulation and Jacket.

C. Heat Trace Thermostat.

D. Heat Trace Panel Wiring.

PART 2. PRODUCTS

2.01 HEAT TRACE CABLE

A. Heat cable shall be U.L. listed, self-regulating, with additional footage at all valves, instruments, and pipe supports, as recommended by the manufacturer. Maximum circuit lengths shall be in accordance with the manufacturer's recommendations.

B. Manufacturer: Heat cable shall be Raychem "5BTV1", 6 watts/ft at 40°F for operation at 120 volts, or equal product as manufactured by Chromalox or Thermon

2.02 HEAT TRACE CABLE INSULATION AND JACKET

A. The insulation shall be performed cellular glass insulation, 1" thick minimum, non-absorptive, impermeable to moisture and impervious to hydrochloric acid.

B. A weather-resistant, watertight, protective finish or jacket shall be applied over all insulation as recommended and manufactured by the insulation manufacturer.

C. Manufacturer: Heat trace insulation shall be Pittsburg Corning “Foamglas”, Armstrong

D. Armaflex II pipe insulation or approved equal.

2.03 HEAT TRACE THERMOSTAT (HTT) AND CONTACTOR (HTC)

A. Heat trace circuits shall be switched through a thermostat, set at 40°F, and a multipole contactor (HTC) as indicated on the Contract Drawings. The contactor shall be NEMA rated, 20 ampere, 120 volts, multipole, with 120-volt control coil. The thermostat shall be weatherproof, line- type, 120 volts

B. Manufacturer: Heat trace thermostat shall be Thermon model B4X

PART 3. EXECUTION

3.01 HEAT TRACE CABLE

A. Spiral the heat cable around the pipe, criss-cross around valves, and attach cable to pipe with GT-66 glass fiber adhesive tape or plastic tie wraps.

B. All power connections to heat trace cable shall be made in watertight j-boxes or with power connection kits recommended by the cable manufacturer. Tees, splices, terminations, and cable shall be of the same manufacturer.

3.02 HEAT TRACE CABLE INSULATION

A. Install insulation over the entire length of piping protected with heat cable. Insulation shall be mitered and nested to cover all tees, fittings, supports, valves, etc. Fitting covers may be performed or field fabricated. The inner bore and joint surfaced shall be coated to fill the surface cells, and all joints shall be sealed as recommended by the manufacturer and secured in place with ½” wide stainless-steel bands.

END OF SECTION

Section 16950

PLC/SCADA Equipment

PART 1. GENERAL

1.01 SUMMARY

A. This specification is confidentially issued for this specific project only.

B. Contractor shall be responsible for reading all specifications from all disciplines prior to bid.

C. The documents shall not be used as a basis for additional compensation due to omission of details of other sections, specifications, documents, and drawings.

D. Furnish all work, labor, tools, staff, material, equipment, and operations necessary to provide and install a complete and functioning electrical system as defined in construction documents.

E. Any equipment, devices, or software required that may be overlooked by engineer or owner's representative shall not absolve responsibility of contractor to provide required equipment or software at no additional cost to owner.

F. It is the intent of the contract document that upon completion of the scope of work, the entire system shall be a finished/workable condition.

G. Major scope of work:

1. All work necessary for a fully operational SCADA operating system.
2. All field testing, shop testing, startup, calibration, adjustment, development of all HMI screens, and all requested automation logic programming required by the contract documents.
3. Additional automation logic programming and HMI screen development may be requested by the authority or owner's representative. This development shall be included at no additional cost to the owner.
4. Full programming of automation logic of all programmable logic controllers, personal computers, servers, historians, laptop computers, human machine interface (HMI), and all other equipment tied into SCADA system.
5. All equipment with registers or address utilized by the PLC requiring modification shall be included in the overall scope of work. Not only new equipment is included in scope of work, existing equipment/SCADA systems may require programming to access into the new system. These modifications and coordination fall into the overall scope.
6. All development and operating software shall be included in contractors' scope of work and shall be provided unsealed and with all licenses, keys, access codes, and required drivers.

7. Coordination with all communication equipment manufacturers including radio, fiber optic, telephone, and data lines required for compatibility and a fully operational SCADA system. All hardware and software shall be included for communication equipment relevant to SCADA System in overall scope of work.
8. Testing of all SCADA systems in conjunction with communication system prior to full startup with stakeholders and inspections.
9. Provide and install all hardware and software required per construction documents and authority standards/requests.
10. Delivery, certification, calibration, adjustment, testing, startup, and recalibration of entire SCADA system.
11. Full 1 – year warranty on entire installation and programming with warranty certificates. Provide separate warranty certificates as required for control panel fabricated equipment and programming of system.
12. Provide full surge protection for all devices.
13. Provide full power quality protection for all devices.
14. Redundant 4-hour UPS power supplies
15. Provide any and all required equipment to comply with warranty certificates.
16. Provide grounding system per NEC Article 250, construction drawings, and technical specifications.

H. High level system requirements:

1. The controller system shall monitor and control the equipment functions stated in the construction documents. Functional requirements shall be coordinated with authority, all manufacturers, and integrators from all disciplines. Lack of coordination that leads to missing equipment and/or services out of scope shall not be used for change order of services. Any additional scope due to lack of coordination shall be at no expense to owner.
2. Under this contract, contractor shall interconnect and setup all systems for full SCADA system.
3. Controls shall operate from a source of 120VAC, 1 phase, 60 Hz UPS.
4. All equipment shall be protected from lighting and other transient voltage events with surge protection devices sized as appropriate. Communication equipment shall be protected from transient events with surge protection devices.
5. Provide condensation protection for panels without climate control. Enclosures shall include continuously operated heaters with thermostats to prevent condensation. Thermostat level shall be coordinated with equipment manufacturer of most sensitive item by a factor of .9 of min/max rating.
6.

1.02 REFERENCES

A. Installations shall conform to all appropriate articles/sections of latest standards, codes, local codes, and ordinances of the owner, authority having jurisdiction, and all entities involved. Contractor shall be responsible for verifying relevance of each reference requirement per the project scope, appropriateness, owner input, and historical requirements. Contractor may submit questions on code requirements where legitimate conflict exists. Relevant references may include all shown below:

1. National Electrical Code (NEC)
2. Underwriters Laboratories (UL)
3. National Electrical Manufacturers Association (NEMA)
4. Insulated Power Cable Engineers Association (ICEA)
5. International Building Code (IBC)
6. National Fire Protection Association (NFPA) 70E – "Standards for safety in the work place"
7. American National Standard Institute (ANSI)
8. Institute of Electrical and Electronic Engineers (IEEE)
9. International Energy Conservation Code (IECC)
10. Texas Center for Environmental Quality (TCEQ)

B. Where contract documents indicate requirements, which are in excess of minimum requirements stated in section 1.03 (A), the most stringent requirements shall be met. Should there be any conflicts between the contract documents and section 1.03 (A), submit RFI's prior to bid.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Contractor is bound to coordinate all equipment and scope of work with engineers and sub-contractors under this contract. Coordination of various equipment installations and operations is required as not to delay scheduled installation and startup.
2. Refer to contractor responsibilities section of this document for further coordination items.

B. Preinstallation meetings

1. Should contractor require a pre-installation meeting for any equipment with engineer, contractor shall provide ample time to schedule all required parties.

C. Scheduling

1. Provide schedule of construction to engineer for review on a monthly basis. Refer to submittal section for further requirements.

1.04 SUBMITTALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

B. The owner, authority, and engineer shall review full SCADA system technical information for compliance with construction documents.

C. Contractor to submit the following items with each submittal as appropriate:

1. Shop drawings
2. Data sheets
3. Wiring diagrams
4. Installation sketches
5. Warranties
6. Testing report documentation
7. Bill of materials
8. Catalog cut sheets
9. General descriptive information
10. Highlighted or boxed catalog numbers and add-ons
11. Relevant specification marked comply, exception, or approved equal

D. Provide the following submittals as part of this specification for review:

1. Wiring devices
2. Block diagrams
3. SCADA system
4. Surge protection devices
5. Control cabinet enclosures
6. Control cabinet wiring and terminal blocks
7. Control cabinet devices and nameplates
8. Control panels
9. Vendor furnished equipment
10. Nameplate designations
11. Programming narratives
12. Bill of materials
13. Development software
14. Operational software
15. Project schedule on a monthly basis
16. Training schedule

17. Training manual document
18. Warranty certificates
19. Testing reports
20. PLC and other equipment updated credentials for administrative rights.

1.05 OPERATIONS & MAINTENANCE MANUALS

A. Refer to specification for Basic Submittal and O&M Requirements 16051

1.06 CONTRACTOR QUALIFICATIONS

A. Contractor, panel manufacturer, and programmer may be required to submit a statement of qualifications to the engineer prior or post bid. Qualifications statement shall show proof of similar plant installations for not less than four (4) recent projects in the region. Provide name of project, owner, address, and contact information for verification of qualifications.

B. Failure to meet acceptable qualifications may lead to disqualification to perform services on this project.

C. All staff assigned to the project shall be full time qualified employees. Contract type employees shall not perform services on this project unless preapproved by engineer. Contractor shall provide proof of experience and employment where requested by owner, engineer, or their representatives.

1.07 SPARE PARTS

A. Spare parts shall be hand delivered to operations team at 75% completion of project completion to operations team.

B. Furnish, tag, and box all spare parts in an organized manner. Provide detailed bill of materials of all items included in box.

C. Provide transmittal form documenting individuals delivering and receiving spare parts with date, signature, printed name, and title. Provide scanned copy to engineer for record keeping. Include documents in O&M manual.

D. Provide the following spare parts:

1. CPU: Provide spare processor unit(s) for each model CPU installed under this contact.
2. Power supply: Provide spare power supply for each model installed.
3. Memory cards: Provide spares for each type of card installed.
4. I/O modules: Provide spare modules for each unique I/O module type installed. Provide 25% additional module points of installed quantity landed. Round up to nearest module where 25% of points exceed spare modules provided by even a single point.

PART 2. PRODUCTS

2.01 GENERAL

A. The functions and features specified in the contract documents are minimum requirements for the overall system. The system shall be equal or exceed requirements.

B. All equipment required under this contract shall be provided and installed, including all appurtenant items not mentioned in documents.

C. All equipment shall be new, unused, and purchased for this project.

D. Provide all like equipment from a single manufacturer where available unless stated otherwise in construction documents. Major equipment such as SCADA system and electrical system do not need to have a single manufacturer provide all equipment.

E. Provide all required I/O modules, communication modules, and equipment required for a fully functional SCADA system. Provide I/O modules required for all terminated signals plus (+) 25% additional spare ports based on total terminated signal cables.

F. All interconnect cables and connectors for controller shall be factory manufactured and/or assembled.

G. All overcurrent protection shall be circuit breaker type, fuses are not allowed.

H. PLC equipment shall not be installed on outer door of control panel with exception of HMI's.

2.02 PROGAMMABLE LOGIC CONTROLLER (PLC) – WATLOW EUROTHERM T2750

A. Communications

1. Two (2) RJ45 ethernet ports
2. Eight (8) port managed network switch with (2) minimum SFP ports for fiber communications
    i. Cisco
    ii. MOXA
    iii. Siemens RuggedCom

B. Input/Output Modules

1. Circuit breaker overcurrent protection
2. Modular plugin type to mounting base
3. LED indicator for status, health, and communication
4. 16 points per discrete input module
5. 16 points per discrete output module

6. 2.5 amp maximum per discrete output module point
7. 16 amp maximum per discrete output module
8. 4 – 20 mA analog input/output range
9. 16 bits across range resolution for analog input points
10. Provide and install isolators and surge suppression devices as specified or recommended by manufacturer
11. 8 points per analog input module
12. 12 bits across range resolution for analog output points
13. Calibration accuracy of analog outputs: better than 0.1% of range from 4 – 20 mA
14. 8 points per analog output module

2.03 HMI

A. Maple Systems Model HMI5104TH Series 10-inch color touch screen

1. Intel Core i3 7101TE
2. 3.4 Ghz
3. 8 GB DDR4 RAM
4. 256 GB Hard Drive
5. Windows 11 Pro (Embedded)
6. Provide Third party Modbus compatibility
7. Provide 1 gigabyte flash drive
8. Provide 1 gigabyte spare flash drive
9. Provide AVEVA Edge 2020 HMI/SCADA Development + Runtime Pakcage software for all sites except lift stations.
    a. HMI/SCADA for Desktop/Server (16,000 tags) - (EDGEDR-16-N-20)
    b. HMI/SCADA for Desktop/Server (4,000 tags) – (EDGER-04-N-20) for lift stations only.
10. One (1) ethernet 10/100 Mbps minimum for communications
11. One (1) seriel RS-232 port for communications
12. Two (2) minimum USB ports

2.04 CONTROLLER

A. Manufacturer: Rosemount

B. Model #: 1056

C. Operating Temperature: -20 C – 60 C (-4 to 140 F)

D. Relative Humidity: 95%

E. Enclosure: NEMA 4X/IP66 metal

F. Power:

1. AC powered 100 – 240 VAC +- 10%, 50/60 Hz
2. 24VDC – 15%

G. Communication:

1. Outputs: (2) 4 – 20 mA or 0 – 20 mA DC isolated outputs. Fully scalable
2. Output accuracy: + or - .05mA at 25 C

H. Various

1. Two (2) analog (0 – 20 mA or 4 – 20 mA) outputs. Each analog output can be assigned to represent a measured parameter.
2. Display: monochromatic graphic liquid crystal display
3. Conduit openings: accepts 1/2" of pg13.5 conduit fittings
4. Ambient Temperature: 0 – 55 C
5. Power: 115/230 VAC
6. Alarms: four (4) configurable alarms for process measurements and temperatures. Each relay configurable independently and with internal timing settings
7. Inputs: two isolated sensor inputs
8. Outputs: Two (2) 4 – 20 mA DC or 0 – 20 mA DC isolated outputs. Fully scalable.
9. Output accuracy: + or - .05 mA at 25 C

2.05 UPS, PS, LOOP ISOLATION

A. Switching type battery supplies are not acceptable.

B. Route fail output relay to PLC for UPS fail alarm.

C. Mean Well SP-200-24 Power Supply

1. Input Voltage: 110
2. Output Voltage: 24
3. Units: V DC
4. Various:
   a. DC Voltage: 24 VDC output
   b. Current range: greater than or equal to 8 – amps
   c. Rated power: greater than or equal to 200 watts
   d. Voltage adjust range: 22V – 26.4 V

e. Frequency range: 47 – 63 Hz
f. Efficiency: 85%

D. APC Smart SRT 1500RM XLA/SRT150 0RMXLA NC UPS

1. Input Voltage: 110
2. Output Voltage 120
3. Units: V DC
4. Communication: Ethernet
5. Various
   a. 2-hour runtime on full load
   b. Automatic reset after power is restored to UPS

E. Acromag 651T Loop Isolator

1. Input: 4
2. Output: 20
3. Units: mA
4. Communication: 4 – 20 mA
5. Various:
   a. Isolation: Inputs, outputs, and channels are isolated from each other for common-mode voltage up to 25VAC, or 354VDC off DC power ground, on a continuous basis
   b. Noise rejection common mode: 100dB at 60 Hz
   c. Normal mode: -5dB at 60 Hz, 100-ohm source
   d. Input bandwidth: -3dB at 45 Hz with 500 ohm load

2.06 SOFTWARE

A. Provide costs in bid for all licensed complete development and operation software required for to program entire SCADA System

B. Provide and furnish all hardware (cables, adapters, etc.) for connection to PLC for development and operation.

C. All software shall be turned over to owner upon substantial complete for future modification, documentation, and development along with associated passwords. Contractor shall maintain license keys and information for a period of 5-years should owner require information at a future date. Failure to maintain records may require contractor to refurnish software. Signed transmittal forms are recommended in order to document exchange of software equipment, license, passwords, and all other relevant information to protect contractor from refurnishing equipment.

D. All software shall be Microsoft Windows based

E. All manufacturer set default passwords shall be reset and credentials shall be provided to engineer for internal documentation.

2.07 SOURCE QUALITY CONTROL

A. Manufacturer to provide guidance and coordination on entire installation of equipment in order to follow all manufacturer recommended procedures. Manufacturer shall be put on contract for on site inspection as required by engineer at no additional cost to owner. Include cost in bid.

B. Operations team shall be consulted upon completion of programming for satisfactory inspection of all developed screens, trends, and automation logic prior to on site startup with owner's representative and engineer.

PART 3. EXECUTION

3.01 GENERAL

A. All signals up to point of PLC terminals shall be tested for accuracy. Replace labels as required once testing has been completed.

3.02 TESTING

A. All equipment shall put through a trial run-in test to ascertain the performance complies with the intent of the specifications. All-in tests shall be made in the presence of the Engineer and owner's representatives.

B. Startup testing shall be performed prior to testing in presence of owner's representative and engineer.

C. Perform all factory test, field tests, and startup tests.

D. Engineer may request inspection prior to upload of program.

3.03 PREPERATION

A. Allow adequate time for coordination, long lead time item orders, programming, and testing under this contract.

B. Mobilization and demobilization time shall be taken into account in overall construction schedule and delays shall be considered into scheduling contingencies.

3.04 INSTALLATION

A. Programmable Logic Controller (PLC)

1. Tie into rugged managed network switch
2. Mounted on din-rail on panel backplane

B. Human Machine Interface (HMI)

1. Tie into rugged managed network switch
2. Mounted on din-rail on panel backplane

C. Labeling

1. In addition to requirements for labeling as specified throughout this section, install as follows:
    a. Phase color insulation is required for all conductors, no exceptions.
    b. Apply numbered wire marking labels to control wires; power wiring in panelboards, pull and junction boxes, and at outlets to identify circuit numbers. Each control wire shall be labeled at each connection. Labels shall heat shrink type.
    c. Apply Phenolic labels with engraved identification to wiring sets in each hand-hole to identify function. Use waterproof labels.
    d. Apply write-on identification labels to empty conduits to identify each with information as to terminus of other end and also trade size of conduit.
    e. Install micarta nameplates with engraving to identify function and/or load served for the following:
        i. Panelboards
        ii. Overcurrent Devices
        iii. Power Quality Monitor
        iv. Control Panels
        v. Automatic Transfer Switch
        vi. Wet Well Junction Box
        vii. All components in control panel and SCADA panel
    f. Micarta nameplates shall be attached with aluminum rivets, use two (2) per each nameplate.
    g. Submit for review a schedule for engraving along with size for each proposed micarta nameplate. Do not fabricate nameplate until review has been completed.
    h. Type circuit directory information on circuit directory cards on all panelboards and laminate.

3.05 SYSTEM STARTUP

A. Upon successful testing, contractor shall provide full system startup in presence of authority, owner’s representative, and engineer presenting fully functional gate operating system with all respective capabilities

B. Contractor is responsible for coordinating with all parties required for system startup including manufacturer's prior to system startup. Ample time is required for coordination.

C. System will be not be accepted by owner until all systems are started and presented to authority, owner's representative, and engineer without issues or pending punch list items

D. Provide the services of factory trained personnel to assist in the installation and start- up of the control system. Pump controller and pump control panel shall be provided by the pump manufacturer. All devices, switches, indicator lights, etc. shall be installed on the panel dead front

3.06 ADJUSTEMENT/CALIBRATION

A. Should initial testing or system startup not present an acceptable functioning system, adjustment/calibration shall be performed as necessary at no additional cost to owner.

3.07 CLEANING

A. Remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work, clean equipment and entire installation site in a workmanlike manner. No loose parts or scraps or equipment shall be left on the premises. Site shall not be accepted by owner where site is not suitably cleaned to engineer or owner's representative preference.

B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer, or with an approved paint.

C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt, and debris.

3.08 TRAINING

A. A full training program for all equipment shall be provided by contractor and programming integrator.

B. Manufacturer may be utilized to perform training. Include any costs for training into bid for no additional cost to owner during construction.

C. The training shall consist of minimum (2) 8-hour days with operations team.

D. Submit training program schedule to engineer for review.

E. Engineer may attend training with operations.

F. Program shall include:

1. Familiarization of all equipment
2. Utilization of installed system
3. Maintenance training

4. Frequently common maintenance items
5. High level screen development overview
6. Deliverable training manual document. Submit to engineer for review.

3.09 CLOSEOUT

A. Substantial completion shall occur only when the below items have been submitted, accepted, and approved.
   1. Submittals
   2. O&M Manuals
   3. Contractor testing
   4. Inspections
   5. Operations team training
   6. Warranty certificates
   7. Shop testing
   8. Record drawings
   9. Spare parts

3.10 MAINTENANCE/WARRANTY

A. Provide extended warranty certificates with contact information to operations and include in Operations & Maintenance manual.

B. Complete and all-inclusive warranty shall be for three (3) years from substantial completion.

C. 24-hour service response time

D. Provide all labor, work, equipment, and materials required at no additional cost to owner.

E. Full replacement of prematurely failed equipment.

F. Where contractor does not repair failures within five (5) working days, owner may put separate integrator under contract to mitigate failures with invoice for labor to be paid by contractor. General contractor shall coordinate this service warranty with sub-contractor. Qualifications for this service shall be the sole responsibility of the general contractor at no additional cost to owner.

END OF SECTION

Title

Preliminary Engineering Report for Galveston, Texas UTMB EST Rehabilitation & Disinfection Project

Site Name

DECEMBER 2023

Purchase Order: P2351608
KH Project Number: 067785106

Prepared for:

Prepared by:

Kimley»Horn

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Section 1: PRELIMINARY ENGINEERING REPORT OVERVIEW

The City of Galveston, Texas (COG) is the owner and operator of a municipal drinking water distribution system that is critically important to the health, safety, and function of the residents and business such as University of Texas Medical Branch (UTMB), Moody Gardens, Schlitterbahn, industries at the Port of Galveston, and Strand, Seawall and other tourist destinations. The system is regulated by the Texas Commission on Environmental Quality (TCEQ) as water system number TX0840003. The system depends on the operation of an Elevated Storage Tank (EST) located adjacent to the UTMB campus at the southwest corner of the intersection of Harborside Drive and North Holiday Drive. UTMB is a high priority/profile water customer of the City of Galveston. This EST is critical to the operations of the hospital. All aspects of this project must be conducted with this understanding, and plans shall be developed with a work sequencing scheme taking this into consideration. The multi-leg EST has a capacity of 1.0 million gallons and was originally constructed in 1958. The EST coating has aged and is approaching the end of its useful service life. Several bracing struts have corroded and require repair or replacement.

The EST rehabilitation will focus on removal of the existing exterior and interior coatings, identification of corroded steel components, repair of damaged bracing and structural components, installation of a new coating system, and modification of EST appurtenances to the current relevant standards. Also, the rehabilitation will potentially include modification of the existing single fill pipe to the proposed two pipe system for fill and discharge, modification of the diaphragm flow control valve and associated piping, electrical design for updating the Supervisory Control and Data Acquisition (SCADA) system interface, flow metering for both inflow and outflow, cathodic protection system, and EST lighting, and addition of a disinfection dosing station. The rehabilitation will include a mixer system to improve water quality.

On August 31, 2023, the COG contracted Kimley-Horn and Associates, Inc. to provide engineering design for rehabilitation and disinfection of the UTMB EST. This preliminary engineering report summarizes the site visit findings, provides recommendations for surface preparation, coating systems and mixing systems, and presents rehabilitation and site improvement recommendations.

This preliminary engineering report describes the following options for the bid items:

- Coating options:
  - Interior Coating System A: 3-Coat Polyamide, Polyamidoamine, or Amine Epoxy certified to NSF/ANSI 61
  - Interior Coating System B: 2-Coat 100% Solids Epoxy certified to NSF/ANSI 61
  - Exterior Coating System C: Rust Inhibitive Epoxy Primer, a High Build Polyamide or Phenylamine Epoxy Intermediate, and a High Performance Acrylic Aliphatic Polyurethane
  - Exterior Coating System D: Rust Inhibitive Epoxy Primer, a High Build Polyamide or Phenylamine Epoxy Intermediate, and a High Performance Polysiloxane Finish Coat
- Water Quality options:
  - Two pipe system for fill and discharge
  - Passive tank mixing system (Tideflex)
  - Active tank mixing system (Kasco)
- Supplemental Bid Items: Includes the EST logo, complete replacement of the altitude valve, disinfection system and water quality analyzer.

Table 1 summarizes the Opinions of Probable Construction Costs (OPCC) for the bid alternatives.

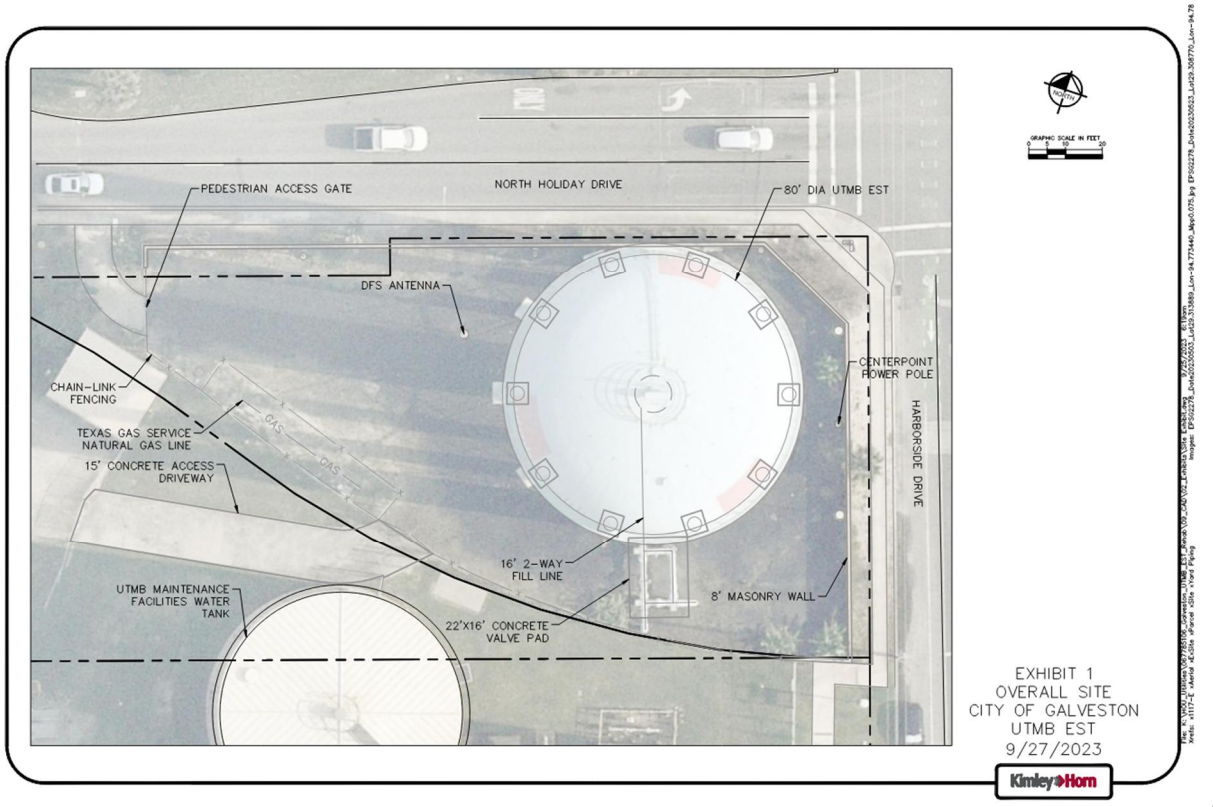
Table 1: OPCC Summary

Water Quality	Interior A / Exterior C	Interior B / Exterior D	Interior A / Exterior C + supplemental items	Interior B / Exterior D + supplemental items
2 pipe system	$ 2,147,000	$ 2,396,000	$ 2,736,000	$ 2,985,000
Passive mixer	$ 2,116,000	$ 2,365,000	$ 2,705,000	$ 2,954,000
Active mixer	$ 2,121,000	$ 2,370,000	$ 2,710,000	$ 2,959,000

Section 2: EXISTING CONDITIONS AND RECOMMENDATIONS

This section documents existing conditions of the EST and surrounding site. This section also lists recommendations for rehabilitation of the EST. Figure 1 shows the existing site including the EST and related appurtenances.

Figure 1: Existing Site Map



2.1. SITE VISIT OBSERVATIONS

Kimley-Horn and Associates, Inc. (Kimley-Horn) conducted an observational site visit to the UTMB EST located on the northeast corner of Harborside Drive and North Holiday Drive in Galveston, Texas. The site visit was performed on Wednesday August 30, 2023 by Mike Shelton, P.E. and Victoria Baltazar, E.I.T. of Kimley-Horn and Dennis Stark (COG).

The purpose of this site observation was to determine the condition of the site, EST, foundations, and accessories. This report presents the observations recorded by Kimley-Horn and provides recommendations for EST repairs, corrosion protection, site improvements, coating systems, and mixing system to UTMB EST. Appendix A includes a proposed site plan on an aerial photo. Appendix B includes the Opinion of Probable Construction Cost (OPCC). The OPCC includes the budget for the rehabilitation and coating of the EST, as well as for improvements to the site, inlet/outlet piping, valves and appurtenances, cathodic protection, mixing systems, chlorine dosing, and electrical systems. This report serves as the basis for preparing plans and specifications for the rehabilitation of UTMB EST during the design phase of the project. This report also provides background information to potential bidders.

Due to the nature of the site visit, the condition of coating in the EST interior and extent of structural repairs required cannot be determined at this time. The contract documents will provide for the contractor to visit the EST during a pre-bid meeting, also final extent of spot repairs to be determined by the engineer after contractor completes initial surface preparation.

2.2. SITE LOCATION AND DESCRIPTION

The multi-leg EST has a capacity of 1.0 million gallons and was originally constructed in 1958. The EST site is approximately 0.29 acres (Galveston County Appraisal District GeoID 0628-0147-0000-000). The parcel legal description is ABST 628 PAGE 133 M MENARD SUR TR 147. The parcel is located adjacent to the UTMB campus. Adjacent to the EST site are UTMB maintenance facilities, including a grey water tank for the campus cooling system.

The site is enclosed by a masonry wall along North Holiday and Harborside and a chain-link security fence with three-strand barbed wire. There are two gates on site: a pedestrian gate on the northwest corner of the property and a double swing chain-link gate off the concrete driveway located towards the southwest. Figure 2 shows ground level photographs of the EST.

Figure 2: Photographs of Existing EST

F

2.3. COATING OBSERVATIONS

According to the name plate (shown in Figure 3), the EST was originally constructed in 1957-1958. At this time, it was common to coat storage tanks with lead-based paints. The EST has been rehabilitated multiple times since the original construction.

Figure 3: UTMB EST Name Plate

In 2003, the EST was blasted and recoated with a PPG coating system. Figure 4 shows the coating schedule posted on the inside of the EST pedestal. The interior coating is still in place and the current condition was not assessed during the site visit. The primer, intermediate, and finish coating were all PPG Aquapon 95-132 series, which is a two-component polyamide-epoxy. The indicated system does not contain lead-based paints.

Figure 4: Coating Schedule from 2003 Rehabilitation

The EST was last rehabilitated in 2013. The 2013 project scope included removal of the existing exterior coating of the EST bowl, application of new exterior coating on the bowl, legs, and dry riser, new exterior piping and FAA

lighting, replacement of structural rods, cleaning and touch up of EST dry interior (including ladders, platforms, and piping), removal and reinstallation/replacement of electrical systems, and site regrading.

As part of the 2013 rehabilitation, the exterior coating was blasted and overcoated. The specifications required installation of a three-coat exterior zinc rich epoxy/epoxy/polyurethane point system. The specifications indicated Tnemec, Carboline, PPV, and Sherwin-Williams systems. None of these specified coatings include lead-based systems.

During the site visit, the exterior coating was observed to have signs of rusting at bolts and weld lines. Also, the ground surface surrounding the site is covered with blast media from previous re-coating projects. Figure 5 shows the extent of this blast media at the EST site.

Figure 5: EST Site Ground Surface

This PER recommends testing, removal, and disposal of the blast media spoils.

2.4. EST EXTERIOR OBSERVATIONS AND RECOMMENDATIONS

The exterior condition of the EST showed signs of corrosion and failure of structural elements. Most notably, one of the bracing cables has completely detached, pictured in Figure 4 below.

EST:

- Diameter: 80-feet
- Height: 140-feet
- Riser: 10-foot dia. dry riser
- Legs: 10
- Construction: Welded steel panels
- Steel Thickness: 0.440” to 0.449”

Piping:

- Fill/Drain Pipe: 16-inch diameter (also known as inflow/outflow)
- Overflow Pipe: 10-inch diameter.
- Appendix C includes overflow sizing calculations. This shows the existing overflow is adequately sized.

Access:

- Ground: 48-inch x 24-inch rectangular door with concrete steps
- Bowl: 30-inch dia. manway. 36-inch balcony with a 36-inch tall railing circumvents the bowl
- Roof: 24-inch dia. hinged hatch, 24-inch dia. auxiliary roof hatch.

- Roof Ladder: 16-inches wide, steps are placed every 12-inches. Non-skid coating

Roof Vent:

- Size: 24-inch diameter
- Type: Double Goose Neck Tee
- Description: Number 24 mesh corrosion resistant screen
- Appendix D includes overflow sizing calculations. This shows the existing vent is adequately sized.

Figure 6: EST Exeterior Photos

2.5. EST INTERIOR OBSERVATIONS AND RECOMMENDATIONS

The interior of the tank was observed from the base pedestal on this site visit. The following design notes and recommendations are discerned from record drawings and information from the City. The base of the dry riser houses a Swan water quality analyzer, SCADA unit, corrosion unit control panel, and an electrical box.

Interior Container Access Ladder:

- Riser Ladder: 16-inches wide, steps are placed every 12-inches.
- Platform: Lower riser platform is 52-inch x 48-inch and the railing surrounding the plate form is 42-inches tall. Upper riser platform is 36-inches x 60-inches and the railing surrounding the platform is 42-inches tall. The lower and upper riser platforms are located at heights of 47-feet and 92-feet, respectively.

Figure 7: EST Interior Photos

Recommendations:

1. Blast exterior coating to expose metal and evaluate integrity for spot welding and repairs.
2. Repair damaged structural bracing.
3. Repurpose existing fill/drain line to operate at the tank drain line.
4. Install 16-inch fill line to a higher tank elevation.
5. Remove SCADA panel from location in pedestal and reinstall in proposed CMU.
6. Remove analyze unit from inside the pedestal and reinstall in proposed CMU.
7. Remove cathodic protection unit and panel.

2.6. YARD PIPING AND VALVE OBSERVATION AND RECOMMENDATIONS

The existing 16-inch fill and drain line is fed by the water distribution system on the east side of the island. System pressure is maintained by constantly running pumps at the 59th and 30th street pump stations. The EST storage elevation is controlled by a Cla-Val altitude check valve to prevent the elevation from exceeding 121-feet.

Figure 8 shows the site plan from the February 2000 plans for the 20-inch water main on Church street. This plan sheet shows how the new (2000) 20-inch pipe and existing 16-inch pipe serve the EST.

The site plan indicates that the 16-inch inlet/outlet pipe runs approximately 36-feet horizontally from the bypass fitting to the dry riser.

Figure 8: EST Site Plan from February 2000

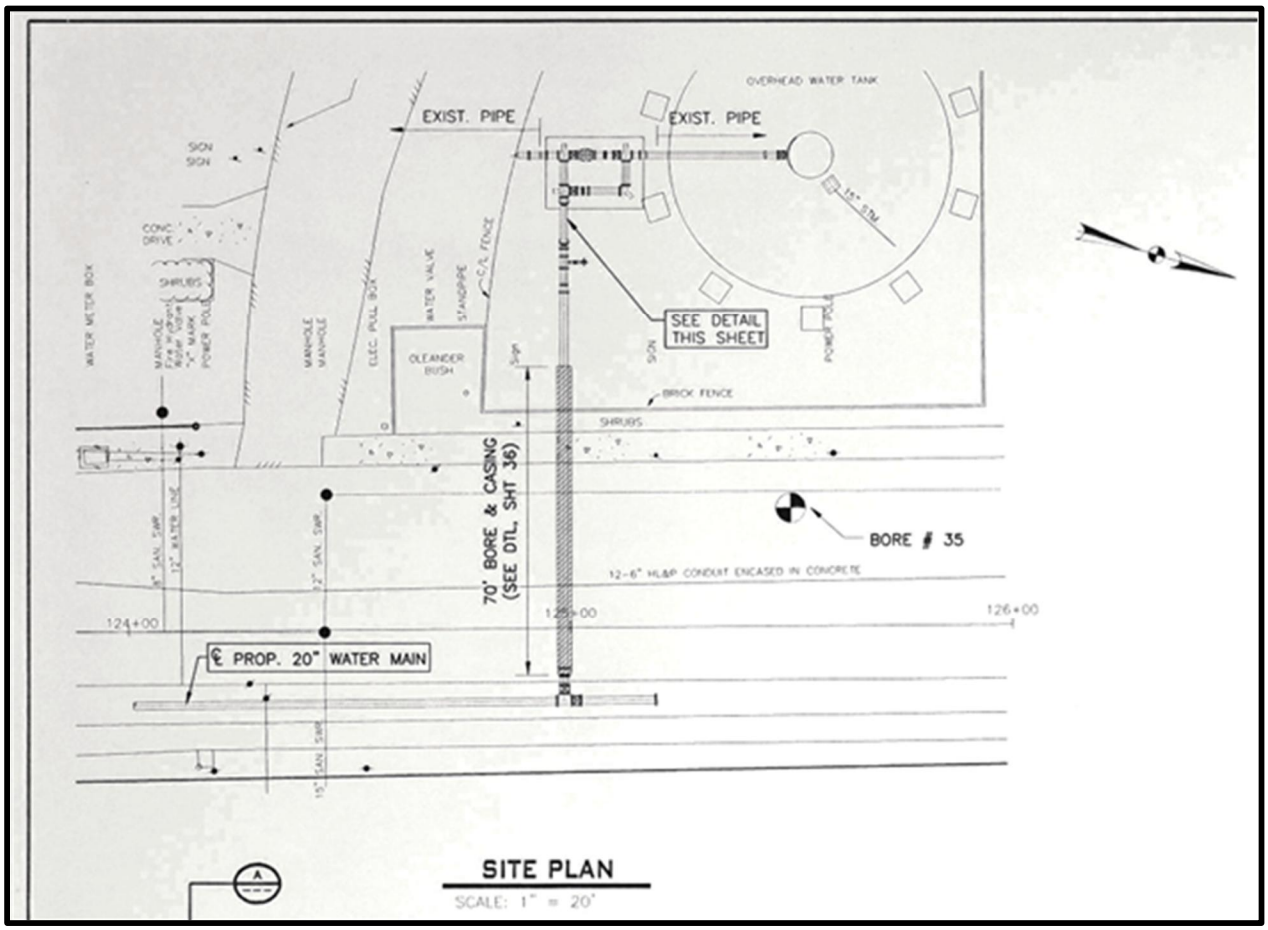
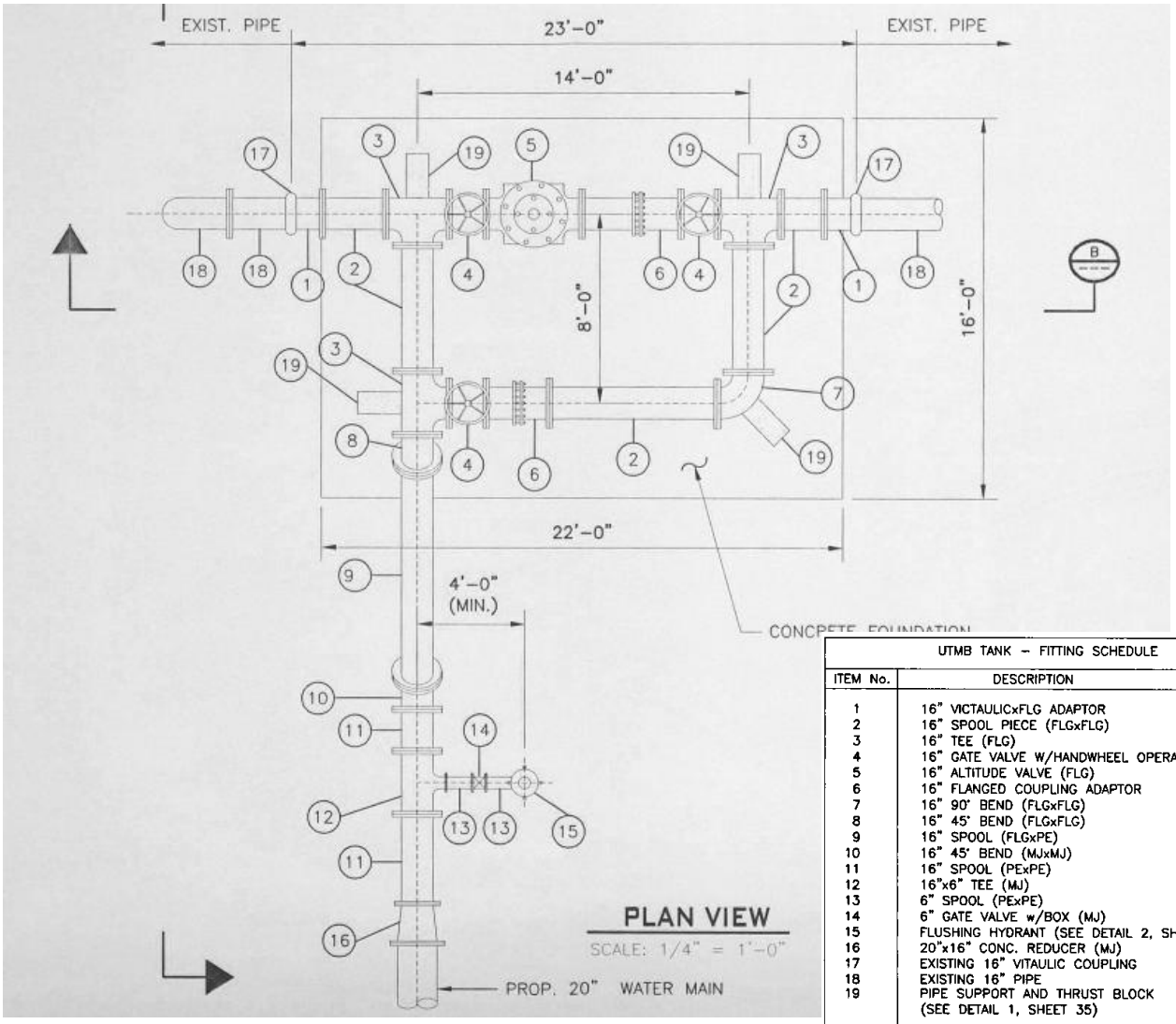


Figure 9 shows the mechanical plan for the altitude control valve. The existing control valve is a 16-inch diameter Cla-Val Model 610 altitude valve for two-way flow. Appendix E includes the manufacturer data for the Cla Val and the pilot control system. The valve includes a CDS6A pilot control set to close the altitude valve when the pressure indicates that the water level in the tank is near the overflow. The piping includes bypass and isolation valves.

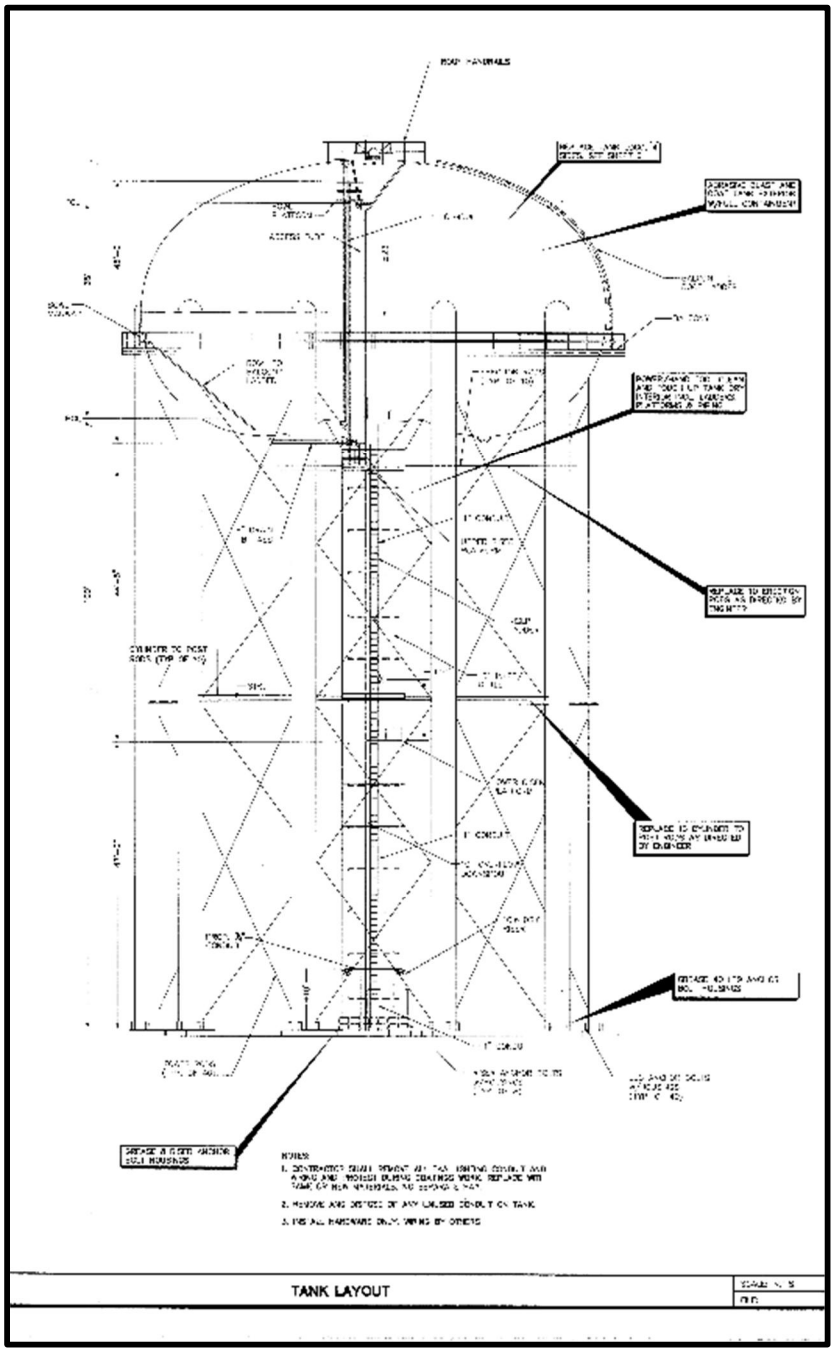
Figure 9: EST Control Valve Piping from February 2000



UTMB TANK – FITTING SCHEDULE	
ITEM No.	DESCRIPTION
1	16" VICTAULICxFLG ADAPTOR
2	16" SPOOL PIECE (FLGxFLG)
3	16" TEE (FLG)
4	16" GATE VALVE W/HANDWHEEL OPERATOR (FLG)
5	16" ALTITUDE VALVE (FLG)
6	16" FLANGED COUPLING ADAPTOR
7	16" 90° BEND (FLGxFLG)
8	16" 45° BEND (FLGxFLG)
9	16" SPOOL (FLGxPE)
10	16" 45° BEND (MJxMJ)
11	16" SPOOL (PExPE)
12	16"x6" TEE (MJ)
13	6" SPOOL (PExPE)
14	6" GATE VALVE w/BOX (MJ)
15	FLUSHING HYDRANT (SEE DETAIL 2, SHEET 35)
16	20"x16" CONC. REDUCER (MJ)
17	EXISTING 16" VITAULIC COUPLING
18	EXISTING 16" PIPE
19	PIPE SUPPORT AND THRUST BLOCK (SEE DETAIL 1, SHEET 35)

The current EST piping is conjured with a single pipe to fill and drain the EST. Figure 10 shows that the 16-inch inlet/outlet pipe runs within the 10-foot diameter dry riser. The inlet/outlet pipe opens a few feet above the Bottom Capacity Level (BCL) of 100-feet above ground surface.

Figure 10: EST Elevation

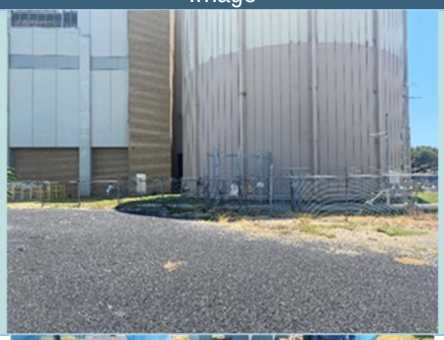


2.7. SITE OBSERVATIONS AND RECOMMENDATIONS

The site is accessed by a 15-foot concrete driveway that ends at the property line. Remnants of blasting media and plyboards from the last renovation provide the only ground cover on site. The chain-link fence is heavily rusted and overgrown with foliage. Texas Gas Services has a gas meter located within the property with its own security fencing that is in a similar condition. Site lighting is provided by five light poles on the property. Appendix F includes additional site photographs documenting the existing conditions.

Table 2: Site Improvement Recommendations

Item	Description	Image
1.	Install 6'x6' concrete masonry unit to house liquid ammonium sulfate (LAS) and chlorine dosing equipment (tanks, injectors, analyzers, scales), and SCADA. Image of example unit shown. Appendix G includes manufacturers information on the analyzer and chloramination system.	
2.	Remove and replace chain-link fencing and 3-strand security barbed wire around entire site.	

Item	Description	Image
3.	Install concrete driveway for vehicle access to proposed chlorine dosing building.	
4.	Remove blast media. Grade site and install gravel for ground cover.	
5.	Relocate Data Flow Services antenna.	
6.	Coordinate with Centerpoint to provide additional power to site.	

The building is anticipated to be comprised of the following elements:

- Foundations: The 6'x6' slab will be a 6" thick slab-on-grade with mild steel reinforcing. A 4'x4' concrete landing pad will be in front of the door.
- Walls: Load bearing CMU with horizontal reinforcement, grouted with vertical reinforcement at 16" on center.
- Roof: Cold formed "C" roof purlins will support the mono-slope roof deck at each end and at the midspan. The roof deck will likely comprise of 1.5" steel panel.

Section 3: SURFACE PREPARATION AND COATING SYSTEM RECOMMENDATIONS

This PER recommends the following surface preparation and coating systems. Appendix H and Appendix I includes coating manufacturers data from Carboline and Sherwin-Williams, respectively.

3.1. SURFACE PREPARATION FOR EST INTERIOR

The following are recommendations for surface preparation of the EST interior:

- Remove all oils, grease, welding fluxes, weld spatter and other surface contaminants prior to blast cleaning in accordance with Society for Protective Coatings Surface Preparation 1 (SSPC-SP1) Solvent Cleaning.
- Sharp edges shall be rounded or chamfered and burrs, surface defects and weld spatter ground smooth before blast cleaning.
- Mark pitting and spot repair locations for confirmation and measurement by inspector. Perform pitting and spot repairs by certified welder.
- The interior of the tank shall be prepared per SSPC-SP10 / NACE No. 2 Near White Metal Blast Cleaning to achieve a minimum surface profile of 2 mils.
- Clean surfaces of dust and residual particles of the cleaning process using dry air-blast cleaning, vacuum cleaning, or other approved methods prior to coating.
- All exposed bare metal shall be primed the same day before flash rusting or contamination occurs.

3.2. COATING SYSTEM FOR EST INTERIOR

Thickness of coatings and paint shall be measured checked according to the procedures outlined in Society for Protective Coatings Paint Application 2 (SSPC-PA 2) "Measurement of Dry Film Thickness (DFT) with Magnetic Gages", May 2012 Edition.

The following are two recommendations for coating systems for the EST interior:

- Interior Coating System A: 3-Coat Polyamide, Polyamidoamine, or Amine Epoxy certified to NSF/ANSI 61
- Interior Coating System B: 2-Coat 100% Solids Epoxy certified to NSF/ANSI 61

Table 3: Interior Coating System A: 3-Coat Epoxy

Coat	Sherwin-Williams System	Carboline System
Prime Coat	Corothane I Galvapac 1K or 2K Zinc 2.5 to 3.5 mils DFT	Carboguard 61 Epoxy 4 to 6 mils DFT
Stripe Coat (all weld seams, edges, corners, bolts, nuts and other difficult to coat areas)	Sherplate 600 Epoxy 3.0 to 6.0 mils DFT applied by brush	Carboguard 61 Epoxy 2 to 3 mils applied by brush
Intermediate	Sherplate 600 Epoxy 4.0 to 6.0 mils DFT	Carboguard 61 4 to 6 mils DFT
Finish Coat	Sherplate 600 Epoxy 4.0 to 6.0 mils DFT	Carboguard 61 Epoxy 4 to 6 mils DFT

Coating system A minimum dry film thickness shall be 10.5 mils. The primer, intermediate and finish coats shall be contrasting colors.

Table 4: Interior Coating System B: 2-Coat 100% Solids Epoxy

Coat	Sherwin-Williams System	Carboline System
Prime Coat	Corothane I Galvapac 1K or 2K Zinc 2.5 to 3.5 mils DFT	Series 94-H2O Hydro-Zinc 2.5 to 3.5 mils DFT
Finish Coat	Dura-Plate UHS Epoxy 18.0 to 20.0 mils DFT	Series 22 Epoxoline or FC22 Epoxoline 20.0 to 40.0 mils DFT

Coating system B minimum dry film thickness shall be 20.5 mils. The primer and finish coats shall be contrasting colors.

This report recommends using the same coating system for both the wetted and dry interior surfaces due to the high humidity within the EST.

3.3. SURFACE PREPARATION FOR EST EXTERIOR

The following are recommendations for surface preparation of the EST exterior:

- Remove all oils, grease, welding fluxes, weld spatter and other surface contaminants prior to blast cleaning in accordance with Society for Protective Coatings Surface Preparation 1 (SSPC-SP1) Solvent Cleaning.
- Sharp edges shall be rounded or chamfered and burrs, surface defects and weld spatter ground smooth before blast cleaning.
- Mark pitting and spot repair locations for confirmation and measurement by inspector. Perform pitting and spot repairs by certified welder.
- SSPC-SP10 / NACE No. 2 Near White Metal Blast Cleaning to achieve a minimum surface profile of 2 mils. Clean surfaces of dust and residual particles of the cleaning process using dry air-blast cleaning, vacuum cleaning, or other approved methods prior to coating.
- All exposed bare metal shall be primed the same day before flash rusting or contamination occurs.

3.4. COATING SYSTEM FOR EST EXTERIOR

The following are three recommendations for coating systems for the EST exterior:

- Exterior Coating System C: Rust Inhibitive Epoxy Primer, a High Build Polyamide or Phenylamine Epoxy Intermediate, and a High Performance Acrylic Aliphatic Polyurethane
- Exterior Coating System D: Rust Inhibitive Epoxy Primer, a High Build Polyamide or Phenylamine Epoxy Intermediate, and a High Performance Polysiloxane Finish Coat

Polysiloxane, also known as siloxane, coatings are a type of coating with a silicon-oxygen based polymer. The silicon and oxygen combination provides greater resistance to UV deterioration and weathering than carbon-based polymers. When combined with an epoxy, siloxane coatings can form higher densities of polymer networks that aid in binding the coating layers together. Siloxane coatings have great color and gloss retention.

Table 5: Exterior Coating System C: 3-Coat High Zinc Epoxy/3 Part Epoxy

Coat	Sherwin-Williams System	Carboline System
Prime Coat	Corothane I Galvapac 1K or 2K Zinc 2.5 to 3.5 mils DFT	Carbozine 859 2.0 to 4.0 mils DFT
Intermediate	Macropoxy 646 FC Epoxy 4.0 to 6.0 mils DFT	Carboguard 60 4.0 to 6.0 mils DFT
Finish Coat	Acrolon Ultra Polyurethane 2.0 to 3.0 mils DFT	Carbothane 134 HS 2.0 to 3.0 mils DFT

Coating system C minimum dry film thickness shall be 8.5 mils. The primer, intermediate and finish coats shall be contrasting colors.

Table 6: Exterior Coating System D: Siloxane

Coat	Sherwin-Williams System	Carboline System
Prime Coat	Corothane I Galvapac 1K or 2K Zinc 2.5 to 3.5 mils DFT	Carbozine 859 2.0 to 4.0 mils DFT
Intermediate	Macropoxy 646 FC Epoxy 4.0 to 6.0 mils DFT	Carboguard 60 4.0 to 6.0 mils DFT
Finish Coat	Sher-Ioxane 800 Polysiloxane 4.0 to 6.0 mils DFT	Carboxane 2000 3.0 to 7.0 mils DFT

Coating system D minimum dry film thickness shall be 10.5 mils. The primer, intermediate and finish coats shall be contrasting colors.

Siloxanes are new coating materials that offer great color and gloss retention. They also offer immersion-grade systems for exterior of tanks, equipment, and structural steel and at the water line inside of wastewater tanks with algae problems. Siloxanes form a very tight and slick film due to its chemistry. This makes siloxanes an important system to consider given the proximity of the UTMB EST to the Gulf of Mexico and the high humidity and potentially corrosive nature of the saltwater.

3.5. EST LOGO

Figure 11 shows a photograph of the current EST logo which features a red UTMB Health logo. Figure 12 shows the 2013 rehabilitation plan sheet showing four orientations of the logo around the EST. During the design phase, Kimley-Horn will provide proposed orientations of the logo as shown from various locations at ground level. For example, this design would consider the orientation of the logo from the view from a driver in the northbound lane of Ferry Road.

This PER proposes submitting the tank logo figure to UTMB for review and approval prior to issuing the project for bids.

Figure 11: Current EST Logo Photo

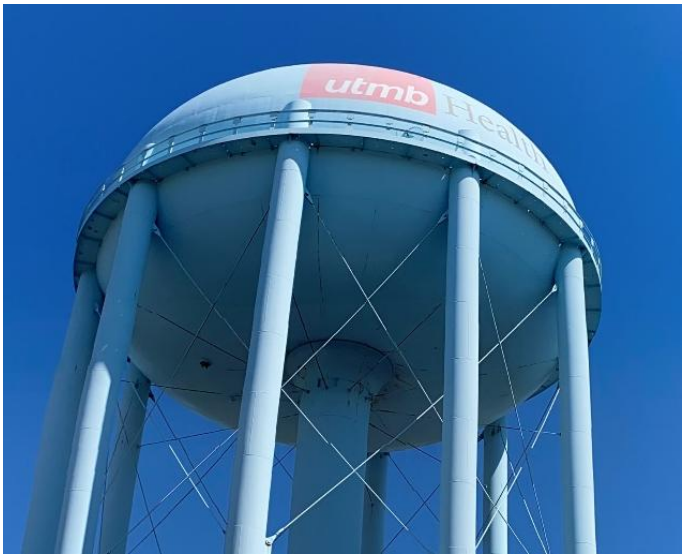
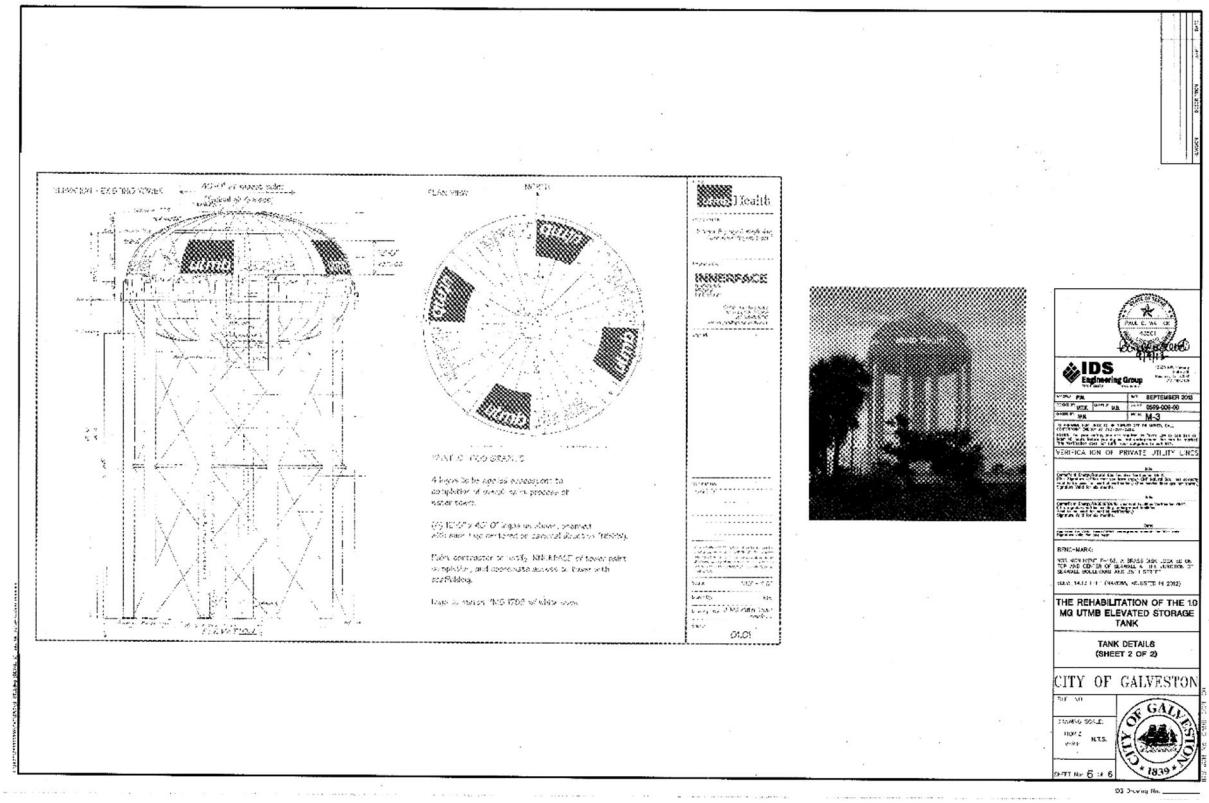


Figure 12: Tank Logo Detail from 2013



Section 4: TANK MIXING SYSTEM ANALYSIS

Galveston water system is chloraminated. This PER recommends installation of a chloramination system to provide boosting of Liquid Ammonium Sulphate (LAS) and chlorine. The system will also include analyzers to monitor the water quality. Appendix G provides manufacturer data for the chloramination system.

In addition to the chlorine dosing station, this PER recommends installation of a tank mixing system to help improve water quality in the EST. Tanks can experience water stratification due to temperature and lack of mixing. This creates zones of dead water, where residual disinfection from chlorine is no longer effective.

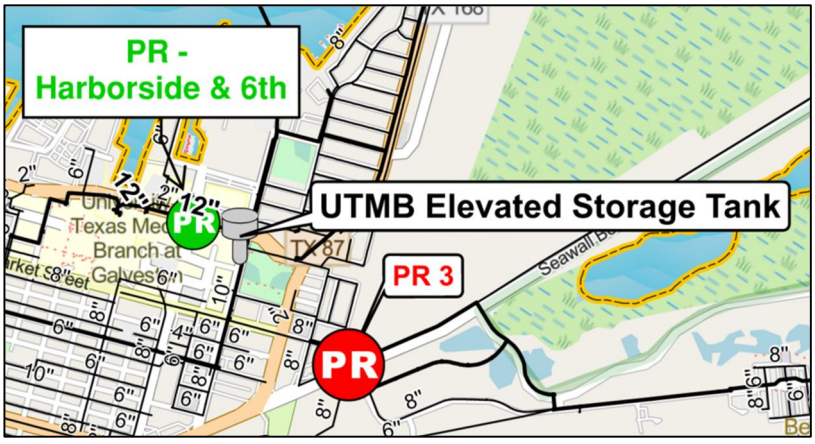
This analysis considers the following water quality options:

1. Two pipe system
2. Passive mixer system (Tideflex)
3. Active mixer system (Kasco)

4.1. PRESSURE ANALYSIS

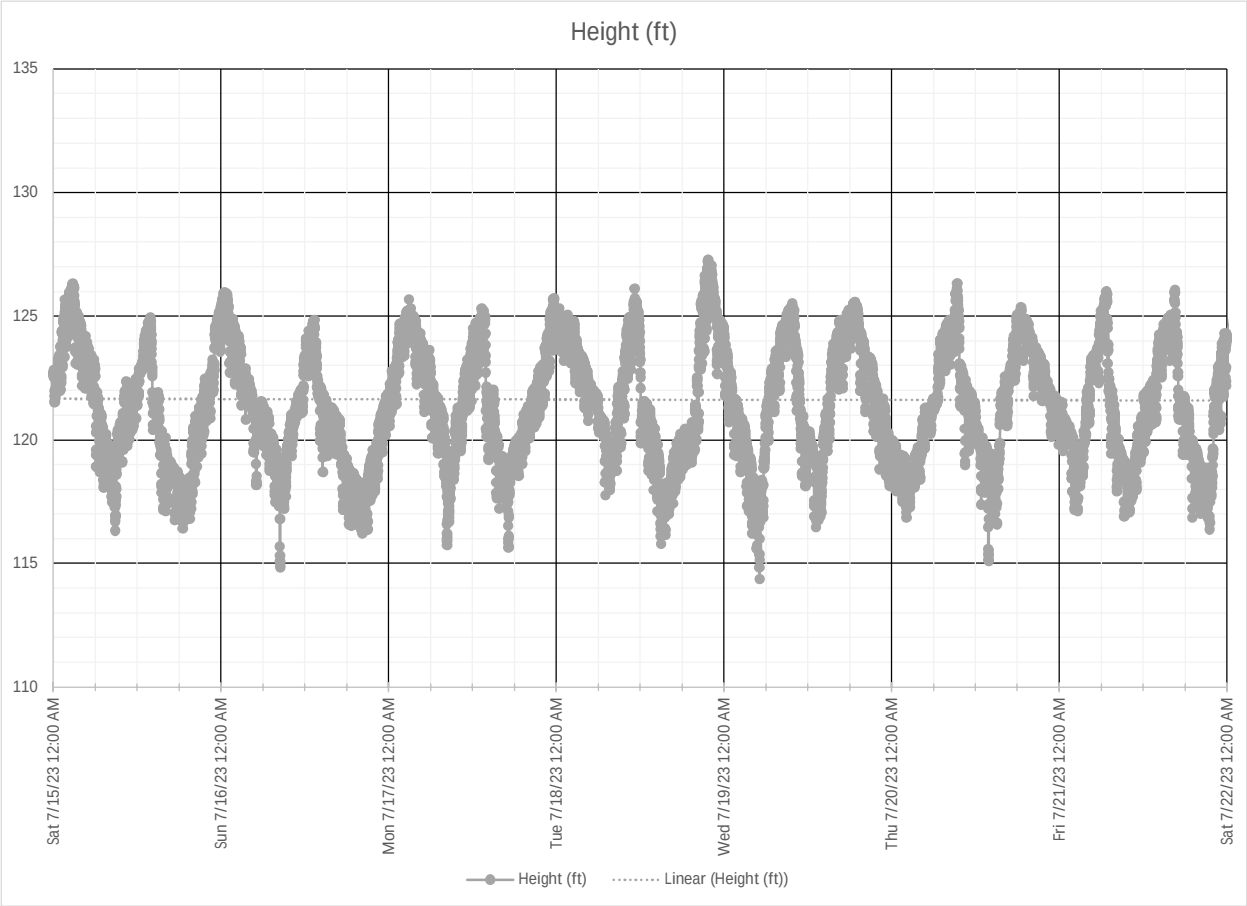
Freese and Nichols, Inc. (FNI) performed pressure recording for 90 days from May 27, 2023 to August 25, 2023. FNI provided data from the pressure gage located on a hydrant near the EST. Figure 13 shows the approximate location in a map provided by FNI. The maximum pressures in the test were 56.2 psi. Assuming that the elevation of the pressure gage at ground level was approximately 9-feet above mean sea level (MSL), the high pressure is approximately equivalent to the overflow elevation of the EST, which is 135-feet above the ground surface, or an elevation of approximately 145-feet MSL).

Figure 13: Pressure Gage Location Map (courtesy of FNI)



The pressure data (translated to height above the gage elevation) indicates that the tank cycles 2 or 3 times each day. Figure 14 shows one typical week of the data indicating the tank water level rising and falling during the day over approximately 12-feet to 14-feet. Since the head range is 35-feet, the top 40% of the tank cycles several times per day. Appendix J includes thirteen weeks of the pressure readings, which indicate a similar pattern. The pressure data indicate that there is adequate turn over in the tank, which means water quality issues can be addressed by splitting the inflow and outflow lines, or adding passive or active mixers.

Figure 14: Pressure Gage Data



Analysis of trends in the typical operation shows that the EST drains and fills at a rate of approximately 800 to 950 gallons per minute (gpm).

City staff indicated when one of the pump stations is not running, the system pressure decreases and elevation in the tank will drop rapidly. The pressure data appear to support this observation. This PER recommends the installation of a dual solenoid system to replace the existing altitude pilot system on the altitude valve. With a dual solenoid system, sensors on the water tank will detect when the level approaches overflow elevation and close. To maintain enough storage for emergency capacity, the valve will close once the water level reaches an elevation of approximately 135-feet above ground level (the overflow elevation).

4.2. TWO PIPE SYSTEM DESIGN

Active and passive systems achieve tank mixing through different means. Passive systems utilize the energy from the incoming water to induce tank mixing. Passive systems include:

- Installing a separate fill pipe at a higher elevation than the outlet to drain older water first
- Installing nozzles on inlet piping to direct incoming water at increased velocities
- Manifolded inlet piping to spread younger water around the tank

A two pipe system design would add approximately 136-feet of pipe to run from the existing bypass line tee up the riser to the Top Capacity Level (TCL) which is an elevation of approximately 135-feet above the ground surface. This system would require two check valves oriented to prevent flow in the wrong direction. This PER recommends an installation of two APCO 90000L check valves as shown in Appendix K.

4.3. PASSIVE TANK MIXER DESIGN

Passive systems are less expensive than active systems and require less maintenance. Based on discussion with the City, Kimley-Horn recommends a passive mixing system be installed on the influent line. Tideflex Mixing Systems (TMS) uses multiple duck bill type Tideflex inlet nozzles at intervals on the inlet pipe to introduce fresh water to the tank. Appendix L shows the Tideflex nozzles proposed for this system.

4.4. ACTIVE TANK MIXER DESIGN

Active systems introduce a mechanical element via impeller or submersible pump to the tank. The equipment requires a power source for the motors and regular maintenance to ensure the system is operating as intended.

The Certisafe potable water tank mixer by Kasco is installed in the tank hung from cables with a stretcher bar. For a 1 MG EST, the mixer will run a 0.5 horsepower motor continuously for complete mixing operation. Appendix M includes the technical data on the proposed mixer.

This system is currently in use at a similar sized ESTs in Texas City and La Marque. This PER recommends the engineer and City staff conduct an interview with Texas City and La Marque staff.

4.5. RECOMMENDED MIXER DESIGN

Kimley-Horn recommends bidding both a passive system and an active system so the City can decide on the system with bid information in hand.

Figure 15: Yard Piping Photos

Recommendations:

1. Move existing appurtenances to new yard piping layout design (see Appendix A for proposed yard piping).
2. Replace Cla-Val altitude pilot system with 131 dual solenoid system.

Section 5: OPINION OF PROBABLE CONSTRUCTION COST

Table 7 summarizes the Opinions of Probable Construction Costs (OPCC) for the bid alternatives.

Table 7: OPCC Summary

Water Quality	Interior A / Exterior C	Interior B / Exterior D	Interior A / Exterior C + supplemental items	Interior B / Exterior D + supplemental items
2 pipe system	$ 2,147,000	$ 2,396,000	$ 2,736,000	$ 2,985,000
Passive mixer	$ 2,116,000	$ 2,365,000	$ 2,705,000	$ 2,954,000
Active mixer	$ 2,121,000	$ 2,370,000	$ 2,710,000	$ 2,959,000

Appendix B shows the detailed OPCC for the project.

Section 6: CONSTRUCTION SCHEDULE

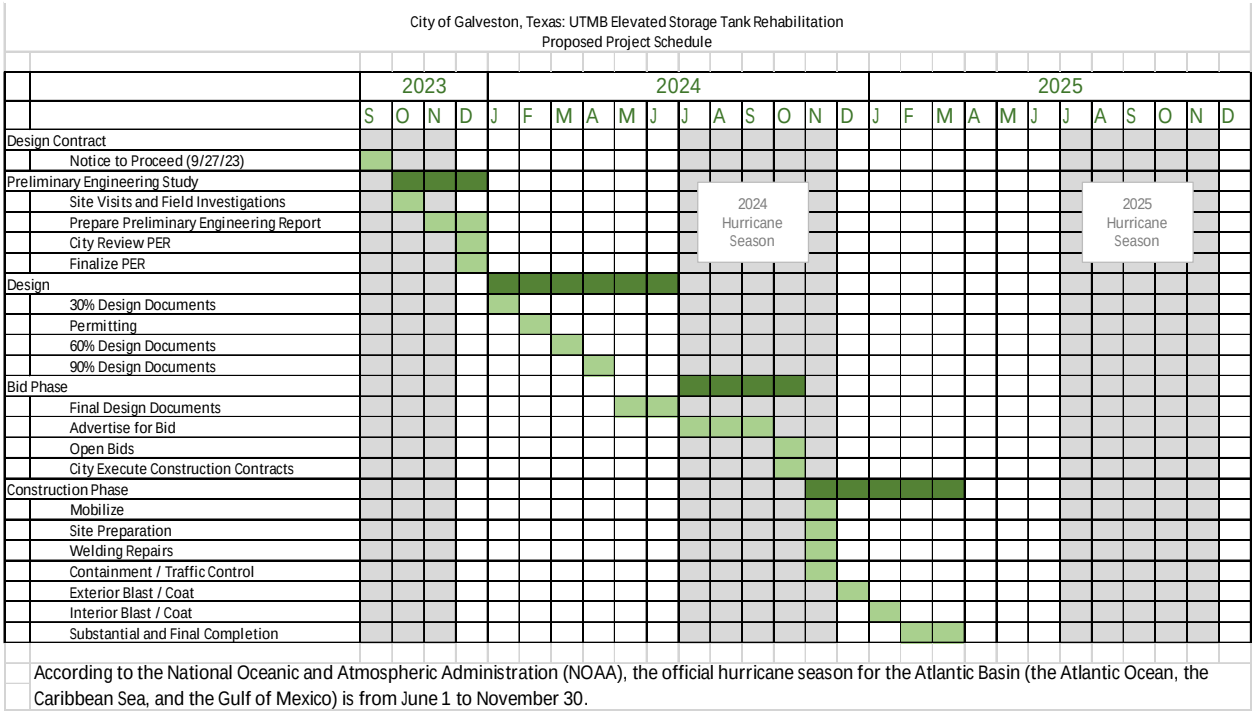
The proposed construction timeline for this project will fall within 120 to 180 days to substantial completion. Construction duration of this project is critical due to the impact of this tank on the water distribution system and its proximity to the UTMB campus. Peak season demand for the COG water system occurs from March to September.

The anticipated construction schedule is as follows:

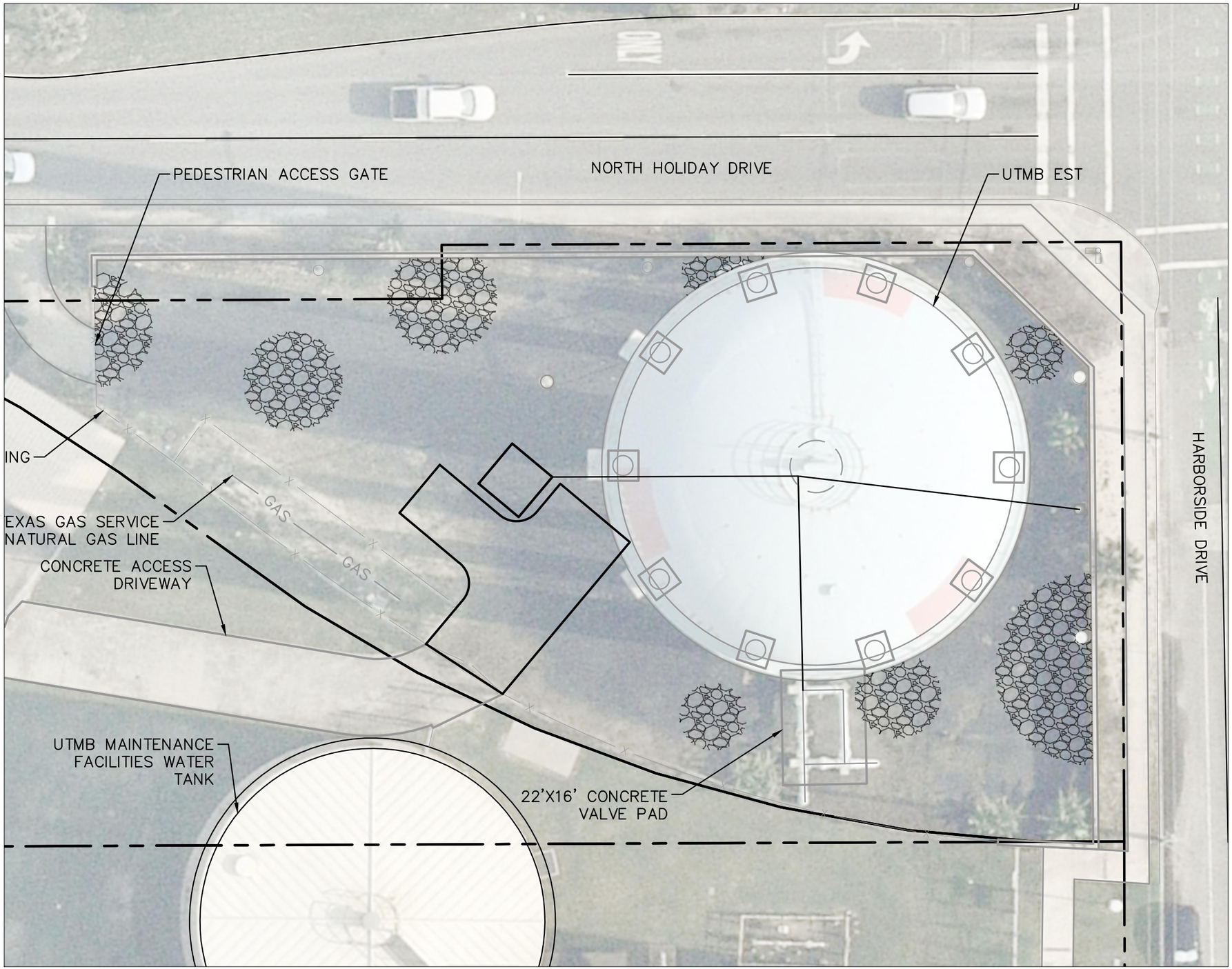
- Notice to Proceed (NTP)
- Mobilization: NTP + 7 days
- Welding Repairs: 30 days
- Containment: 15 days
- Exterior Blast / Coat: 60 days
- Interior Blast / Coat: 45 days
- Substantial Completion: 15 days
- Final Completion / Commissioning: 15 days
- Demobilization: 7 days

Figure 16 shows this schedule as a Gantt chart assuming a bid opening date of October 2024 to coincide with the end of the storm season.

Figure 16: Project Schedule



Appendix A: Site Aerial Exhibit



NORTH

GRAPHIC SCALE IN FEET
0 # ## ##

EXHIBIT 1
OVERALL SITE
CITY OF GALVESTON
UTMB EST
9/29/2023

Kimley»Horn

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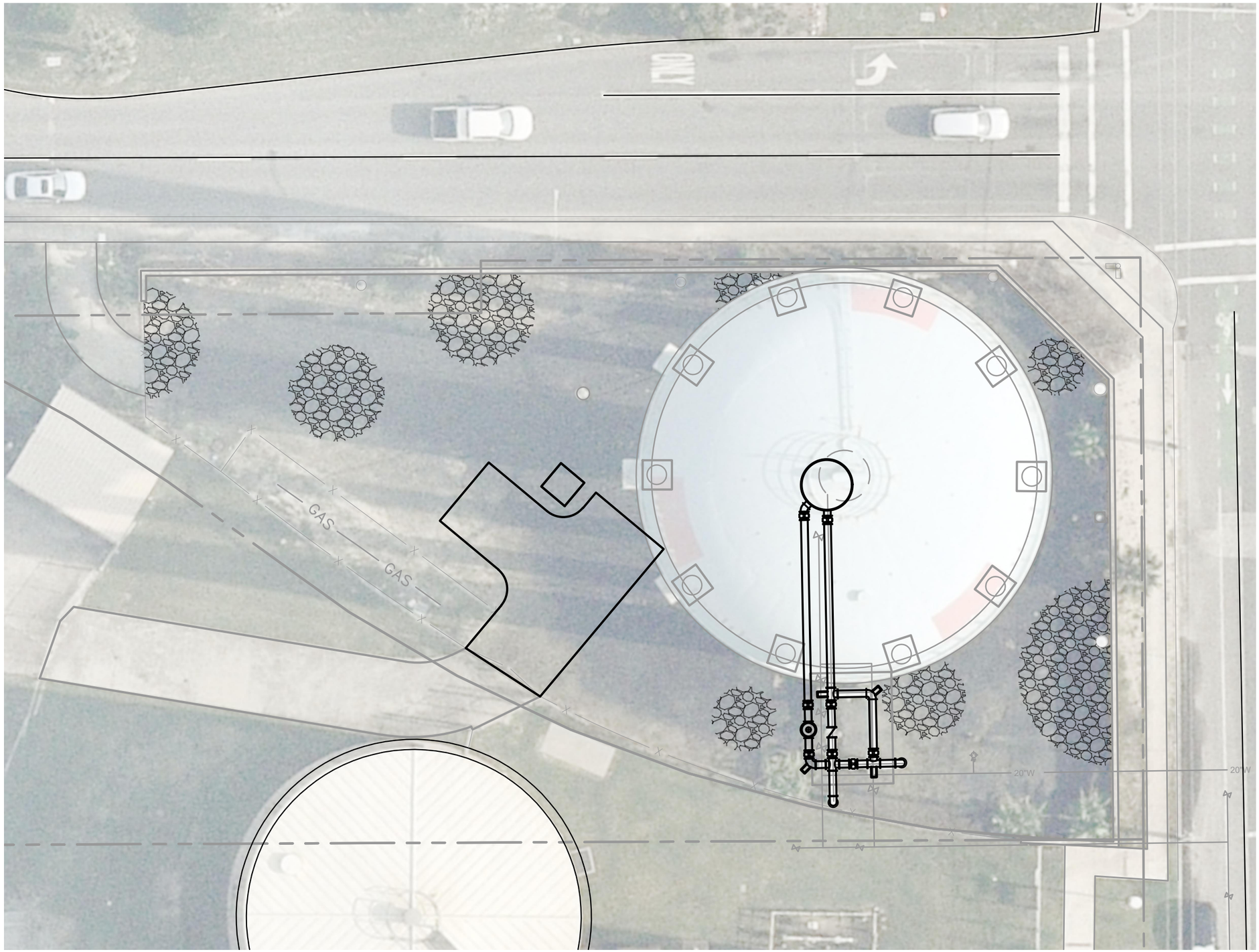


NORTH

GRAPHIC SCALE IN FEET
0 5 10 20

EXHIBIT 2
PROPOSED SITE
CITY OF GALVESTON
UTMB EST
9/27/2023

Kimley»Horn

File: K:\HOU_Utilities\067785106_Galveston_UTMB_EST_Rehab\09_CAD\04_References\xSite.dwg 9/25/2023 10:26am
Xrefs: xAerial xParcel x1117-E xExSite xYard Piping xWater
Images: EPSG2278_Date20230503_Lat29.313889_Lon-94.773440_Mpp0.075.jpg EPSG2278_Date20230523_Lat29.308770_Lon-94.7

Appendix B: Opinion of Probable Construction Costs

Kimley-Horn and Associates, Inc. **Opinion of Probable Construction Cost**

Client:	**City of Galveston, Texas**	**Date:**	**10/13/2023**
Project:	**UTMB EST Rehabilitation**	**Prepared By:**	**VGB**
KHA No.:	**067785106**	**Checked By:**	**MAS**

Base Bid

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
1	Construction Mobilization	1	LS	$ 46,000	$ 46,000
2	Dehumidification	1	LS	$ 35,000	$ 35,000
3	Containment	1	LS	$ 80,000	$ 80,000
4	Remove blast media spoils	1	LS	$ 30,000	$ 30,000
5	Remove and Replace Steel Cable Bracing	300	LF	$ 8	$ 2,400
6	Remove and Replace Exterior Vent, Handrails, FAA Lighting	1	LS	$ 25,000	$ 25,000
7	16-inch Ductile Iron Piping	40	LF	$ 200	$ 8,000
8	16-inch Gate Valve	1	EA	$ 16,000	$ 16,000
9	Altitude Valve Assembly Rehabilitation (Cla-Val 131 Pilot System)	1	LS	$ 30,000	$ 30,000
10	Flow Meter	2	EA	$ 30,000	$ 60,000
11	Electrical and Power Supply	1	LS	$ 50,000	$ 50,000
12	SCADA Relocation	1	LS	$ 24,000	$ 24,000
13	SCADA Upgrades	1	LS	$ 15,000	$ 15,000
14	Tank Level System	1	LS	$ 5,000	$ 5,000
15	DFS Antenna Relocation	1	LS	$ 5,000	$ 5,000
16	Bowl Lighting (LED)	1	LS	$ 30,000	$ 30,000
16	FAA lighting	1	LS	$ 17,000	$ 17,000
17	Remove and Replace 10-foot Gate	1	EA	$ 3,000	$ 3,000
17	Remove and Replace 8-foot Gate	2	EA	$ 2,500	$ 5,000
18	Remove and Replace 6-foot Chain-link Fence with 3-strand Barbed Wire	270	LF	$ 80	$ 21,600
18	Install Concrete Driveway	110	SY	$ 120	$ 13,200
19	Install 6-inch thick Flex Base Surface	1,425	SY	$ 50	$ 71,250
19	Site Grading	1	LS	$ 20,000	$ 20,000
20	Storm Water Pollution Prevention Plan (SW3P) and Erosion Control	1	LS	$ 5,000	$ 5,000
20	Traffic Control Plan	1	LS	$ 10,000	$ 10,000
	Water Quality System				
W1	16-inch Stainless Steel Piping	176	LF	$ 230	$ 40,480
W2	16-inch Double Check Valve	2	EA	$ 12,000	$ 24,000
	Coating System				
C1	Interior Coating System A (zinc primer, 2-coat epoxy)	1	LS	$ 221,000	$ 221,000
C2	Exterior Coating System C (zinc primer, 3-coat epoxy)	1	LS	$ 738,000	$ 738,000
				Subtotal:	$ 1,651,000
				Contingency (30%)	$ 496,000
				Total Base Bid	**$ 2,147,000**

Alternate Bid: Coating System

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
C3	Interior Coating System B (zinc primer, 3-Coat Epoxy)	1	LS	$ 265,000	$ 265,000
C4	Exterior Coating System D (zinc primer, Epoxy, Siloxane)	1	LS	$ 885,600	$ 885,600
				Subtotal:	$ 1,842,600
				Contingency (30%)	$ 553,000
				Total Alternate Bid	**$ 2,395,600**

Alternate Bid: Water Quality

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
W3	Tank Mixing System: Passive	1	LS	$ 25,000	$ 25,000
				Subtotal:	$ 25,000
				Contingency (30%)	$ 8,000
				Total Alternate Bid	**$ 33,000**

Alternate Bid: Water Quality

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
W4	Tank Mixing System: Active	1	LS	$ 29,000	$ 29,000
				Subtotal:	$ 29,000
				Contingency (30%)	$ 9,000
				Total Alternate Bid	**$ 38,000**

Supplemental Bid Items

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
S1	Tank Logo	3	EA	$ 12,000	$ 36,000
S2	Structural Steel Spot Repairs	100	LBS	$ 45	$ 4,500
S3	Altitude Valve Assembly Replacement (Cla-Val 610)	1	LS	$ 120,000	$ 120,000
	Disinfection System				
S4	Chlorine Disinfection Dosing System (tanks, pumps, feeder, injectors, scales, monitoring equipment, shutoff valve, control panel, eyewash station, misc. pipes and fittings)	1	LS	$ 89,000	$ 89,000
S5	LAS Disinfection Dosing System (tanks, pumps, feeder, injectors, monitoring, control, pipes and fittings)	1	LS	$ 65,000	$ 65,000
S6	Tank Chlorine Analyzer System	1	LS	$ 38,000	$ 38,000
S7	Chlorination Enclosure Building (6'x6' Concrete Masonry Unit)	1	LS	$ 100,000	$ 100,000
				Subtotal:	$ 453,000
				Contingency (30%)	$ 136,000
				Total Supplemental Bid	**$ 589,000**

Basis for Cost Projection:

- ☑ No Design
- ☐ Preliminary
- ☐ Final Design

The Consultant has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Consultant at this time and represent only the Consultant's judgment as a design professional familiar with the construction industry. The Consultant cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

Appendix C: Vent Sizing Calculations

City of Galveston, Texas UTMB: Elevated Storage Tank: Vent Calculations

Designed: VGB Checked: MAS

9/13/2023

Check that the roof vent capacity is greater than or equal to the maximum volume entering or leaving the EST.

Given:

Top Capacity Level (TCL):	135	feet	above ground
Bottom Capacity Level (BCL):	100	feet	above ground
Head Range:	35	feet	
D: Inflow Pipe Diameter:	16	inch	
Pipe Length:	136	feet	

1. Maximum Inflow

Hazen Williams Formula			
C factor:	110	unitless	
R: Pipe Radius:	8	inches	
A: Pipe Area	201.1	square inches	
A: Pipe Area	1.40	square feet	
Pw: Wet Perimeter:	50.3	inches	
Pw: Wet Perimeter:	4.2	feet	
Rh: Hydraulic Radius:	0.333	feet	
Sp: System Pressure at 70 psi:	162.0	feet	0.3
Head (Sp - BCL + 5)	57.0	psi gauge	
S: Slope Energy Line (hf/L):	0.419		
Q = 1.318*C*Rh^0.63*S^0.54*A	63.35	cubic feet per second (cfs)	
Qin: Inflow:	63.35	cfs	

2. Maximum Outflow

Orifice Flow:			
H: Head at BCL:	35	feet	
Cd: coefficient:	1		for well-rounded entrance
A: Area:	1.40	square feet	
Q = Cd*A*(2*g*h2)^(0.5):	66.39	cfs	
Q: Riser Flow:	66.39	cfs	

3. Design Flow

Larger of 1. and 2.:	66.39	cfs

4. Vent Capacity

Vent diameter:	30	inches
Vent Area:	4.91	square feet
Number of Vents:	1	
Total Vent Area:	4.91	square feet
V: Velocity Limit:	2200	fpm
Vent Capacity: Q=VA:	180.0	cfs

5. Compare

Q: Design Flow:	66.39	cfs
Qcap: Max Vent Capacity:	180.0	cfs

Inflow < Capacity

therefore vent is properly sized.

Appendix D: Overflow Sizing Calculations

City of Galveston, Texas UTMB: Elevated Storage Tank: Overflow Calculations

Designed: VGB Checked: MAS
9/13/2023

Check that the overflow pipe capacity is greater than or equal to the maximum tank inflow.

1. Maximum Inflow

Top Capacity Level (TCL):	135	feet	above ground
Bottom Capacity Level (BCL):	100	feet	above ground
Head Range:	35	feet	
D: Inflow Pipe Diameter:	16	inch	
Pipe Length:	136	feet	
Hazen Williams Formula			
C factor:	110	unitless	
R: Pipe Radius:	8	inches	
A: Pipe Area	201.1	square inches	
A: Pipe Area	1.40	square feet	
Pw: Wet Perimeter:	50.3	inches	
Pw: Wet Perimeter:	4.2	feet	
Rh: Hydraulic Radius:	0.333	feet	
Pd: Pressure Drop:	3.465	psi gauge	
S: Slope Energy Line (hf/L):	0.025		
Q = 1.318*C*Rh^0.63*S^0.54*A	13.96	cubic feet per second (cfs)	
Qin: Inflow:	13.96	cfs	

2. Capacity of Overflow

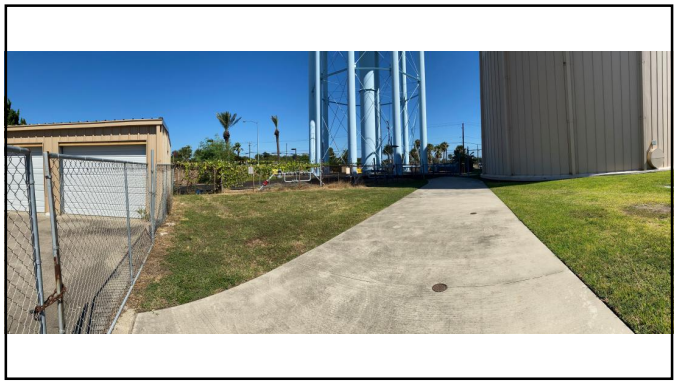
weir length:	5	feet	
weir depth:	4	feet	
L: Weir Length:	18	feet	
h1: Head above weir	0.5	feet	
D: Overflow Diameter:	12	inches	
H: Height above downspout:	4	feet	
h2: head:	4.5	feet	
Cw:	3.33		for sharp-crested weir
Qcap = Cw*L*h1^(3/2):	21.19	cfs	
Qcap: Flow capacity:	21.19	cfs	
Orifice flow:			
Cd: coefficient:	1		for well-rounded entrance
A: Area:	0.79	square feet	
Q = Cd*A*(2*g*h2)^(0.5):	13.39	cfs	

3. Compare

Qin: Max Inflow:	13.96	cfs
Qcap: Max Outflow Capacity:	21.19	cfs

Inflow < Capacity
therefore pipe is properly sized.

Appendix E: Additional Site Visit Photographs



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AVISO
GAS
OLEODUCTO
DON'T DIG UNTIL YOU CONTACT YOUR LOCAL ONE-CALL SYSTEM
NOTICE:
DAMAGE OR REMOVAL OF THIS SIGN IS A FEDERAL OFFENSE SUBJECT TO A $5000 FINE AND/OR 1 YEAR IMPRISONMENT
WARNING
NATURAL GAS
PIPELINE
Texas Gas Service.
BEFORE DIGGING CALL
1-800-344-8377
IN CASE OF EMERGENCY
1-800-959-5325

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AVISO
GAS
OLEODUCTO
NOTICE:
DAMAGE OR REMOVAL OF THIS SIGN IS A FEDERAL OFFENSE SUBJECT TO A $5000 FINE AND/OR 1 YEAR IMPRISONMENT
WARNING
HIGH PRESSURE
NATURAL GAS
PIPELINE
Texas Gas Service.
BEFORE DIGGING CALL
1-800-344-8377
IN CASE OF EMERGENCY
1-800-959-5325

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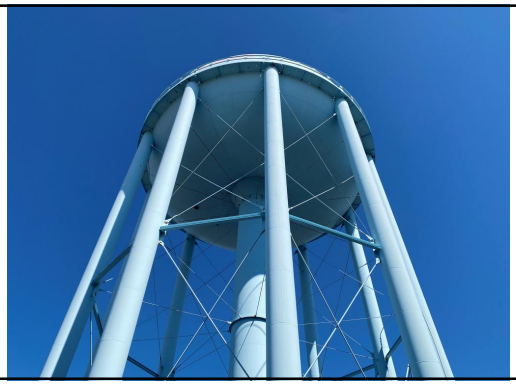

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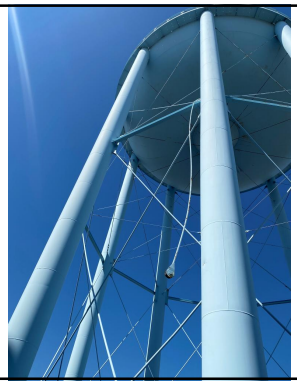

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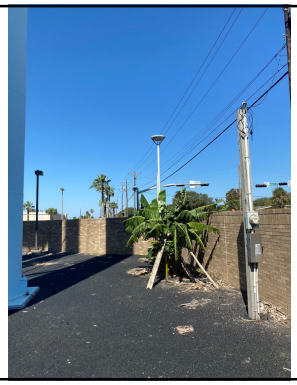

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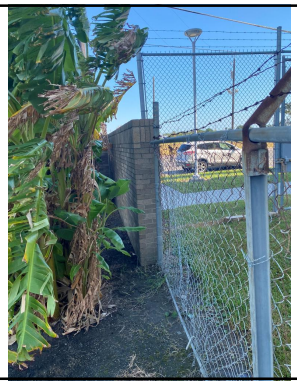

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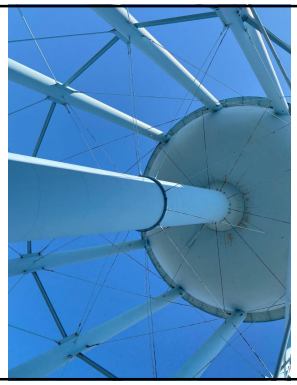

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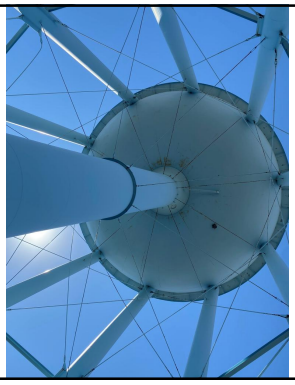

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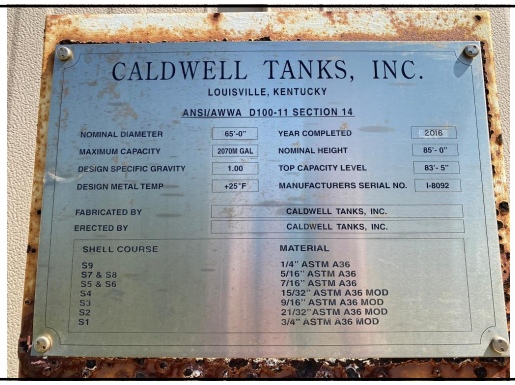

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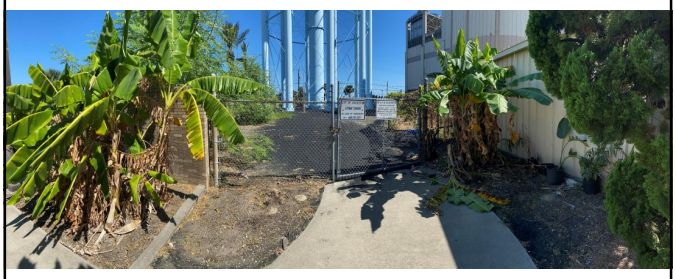

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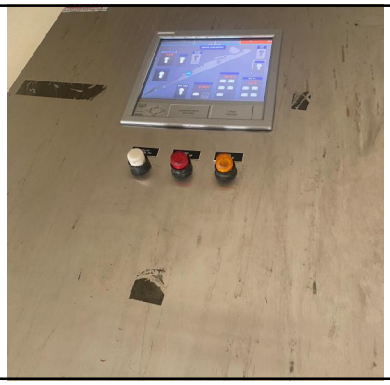

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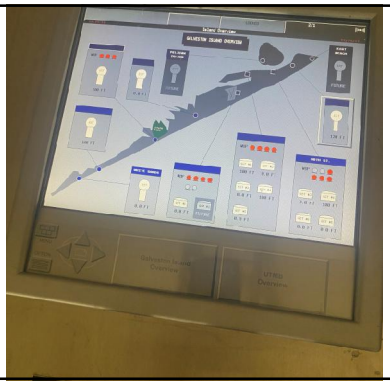

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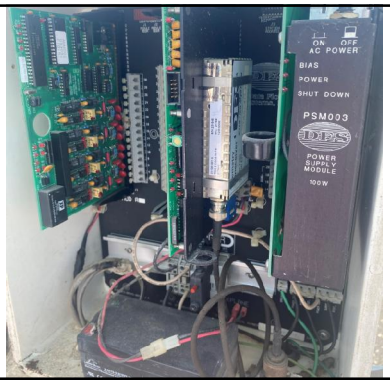

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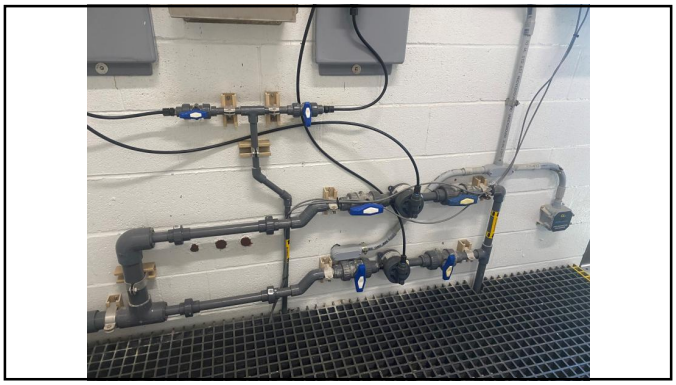

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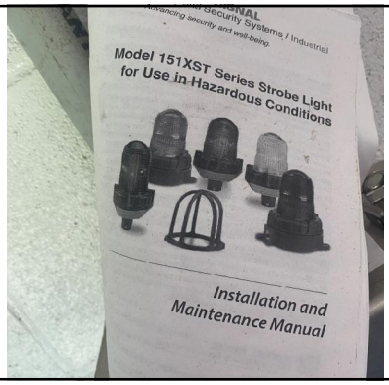

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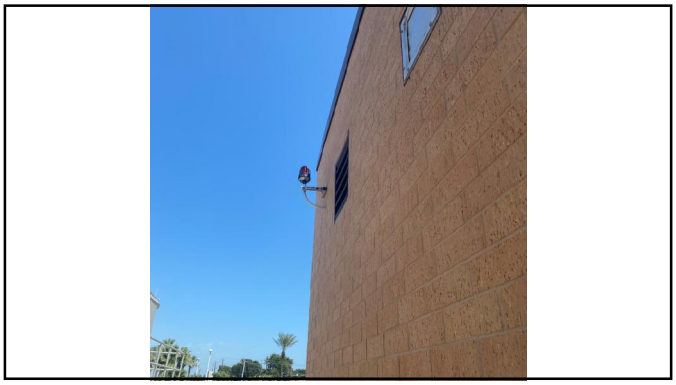

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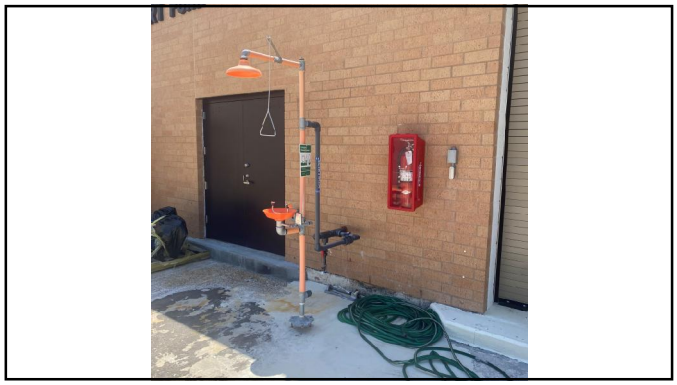

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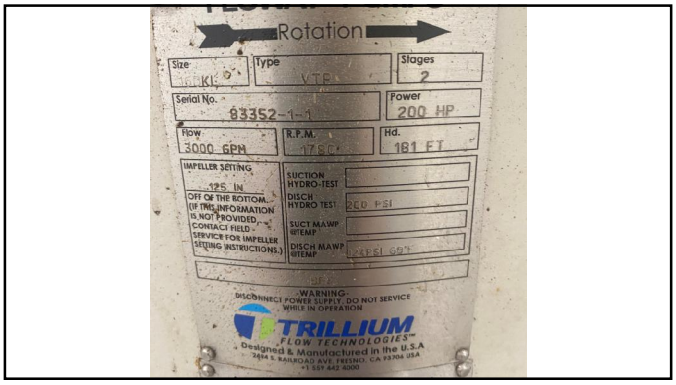

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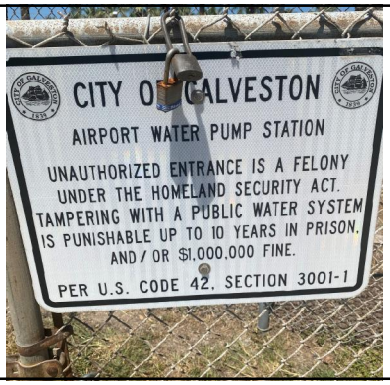

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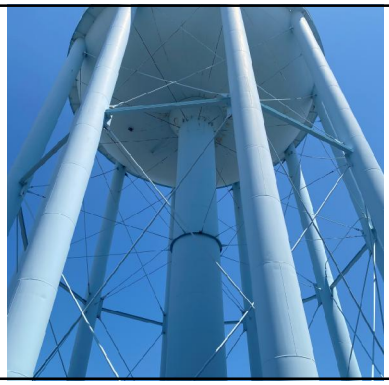

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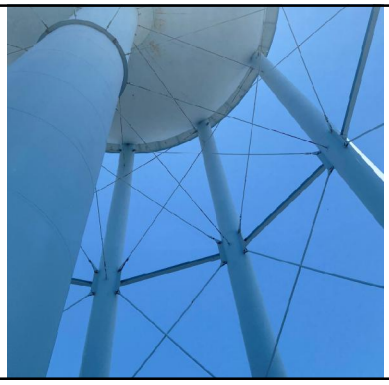

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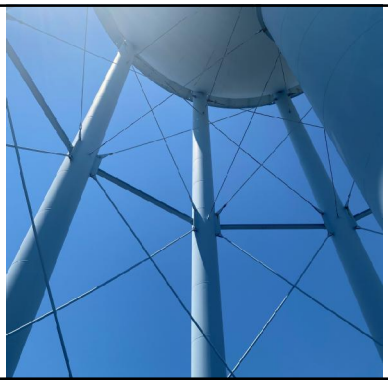

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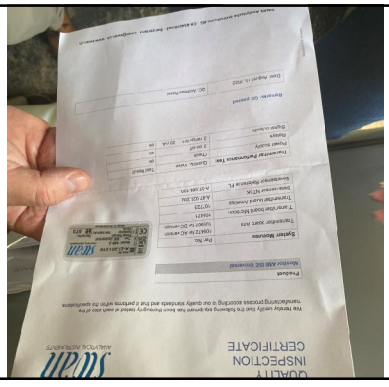

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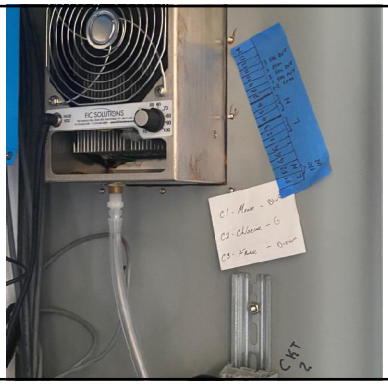

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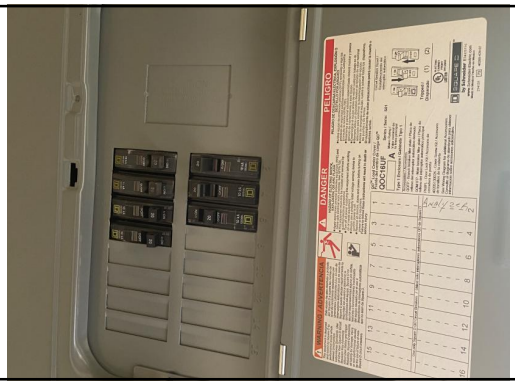

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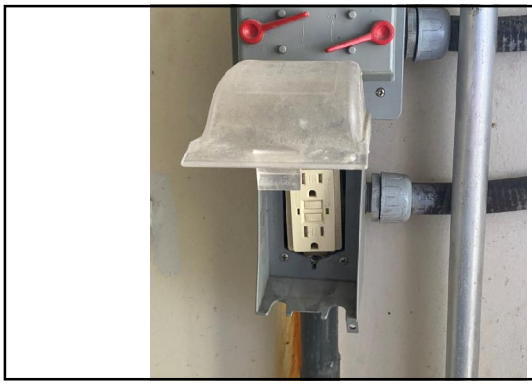

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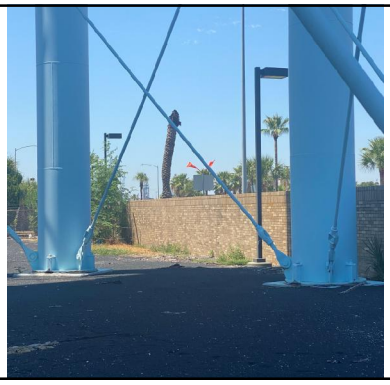

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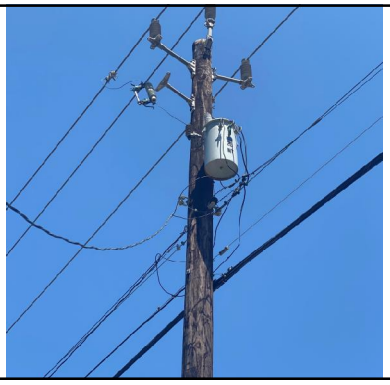

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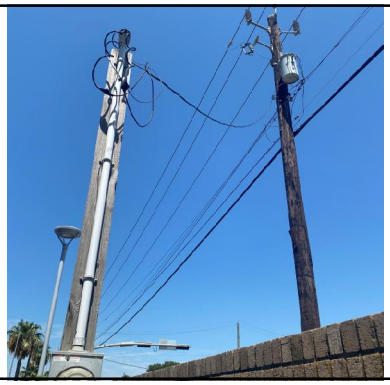

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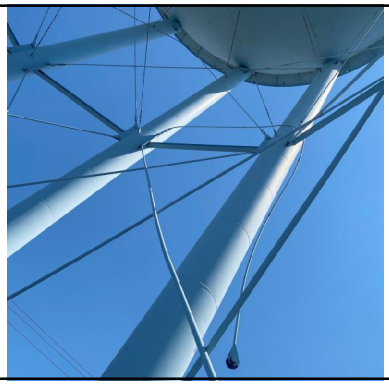

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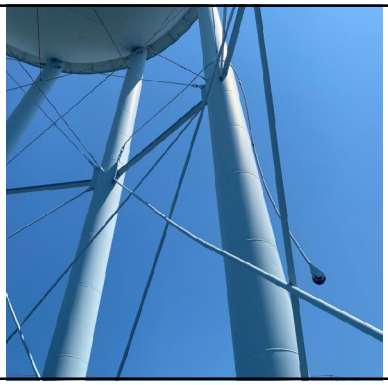

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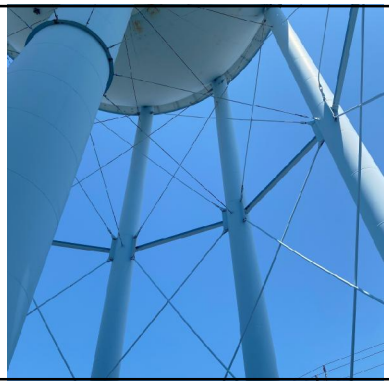

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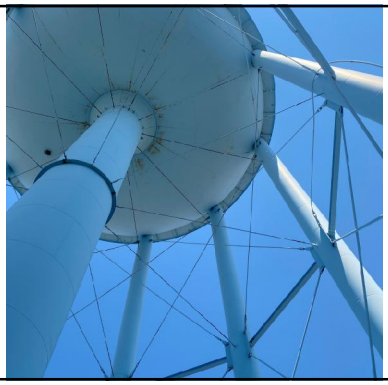

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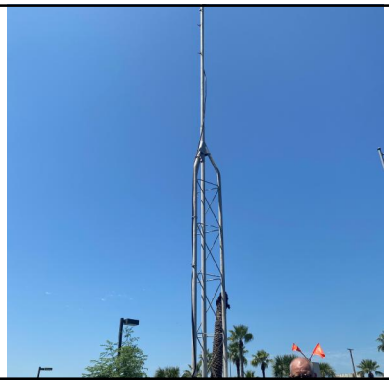

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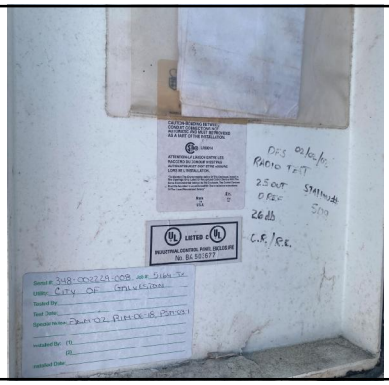

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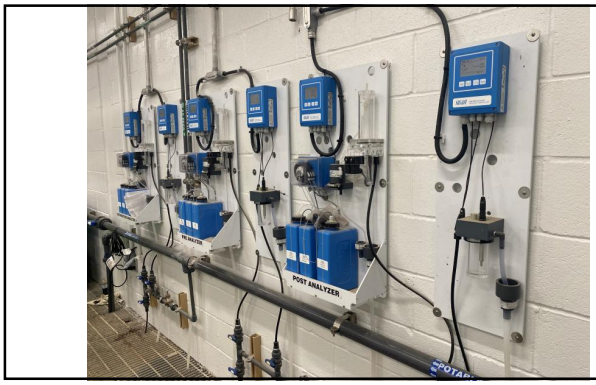

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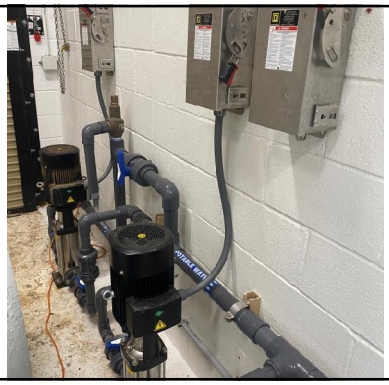

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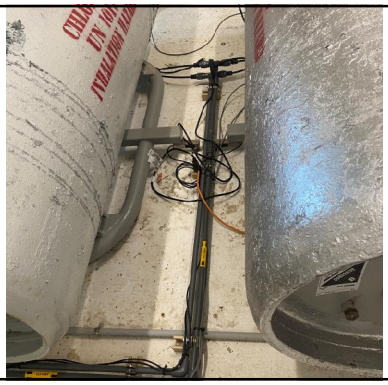

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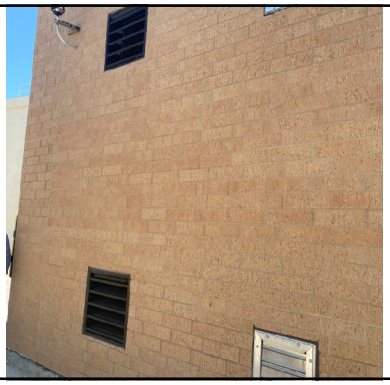

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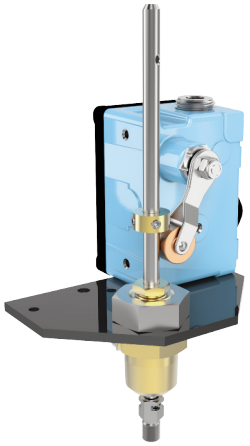
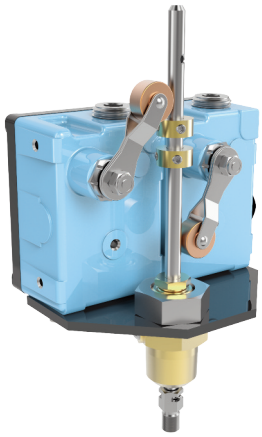
Appendix F: Altitude Valve

CLA-VAL™

MODELS **X105L**
X105L2

Limit Switch Assemblies



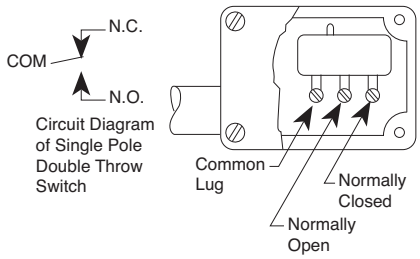


- **UL/ULC Listed**
- **Positive Action**
- **Rugged and Dependable**
- **Weather Proof or Explosion Proof**
- **Easy To Adjust**

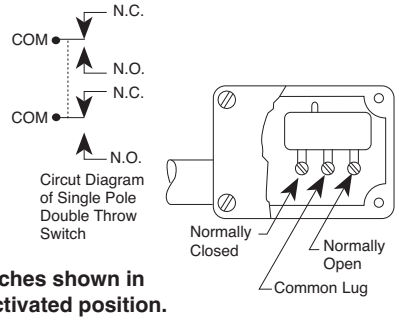
The Cla-Val Model X105L/X105L2 Limit Switch Assembly is a rugged, dependable and positive acting switch assembly actuated by the opening or closing of a Cla-Val control valve on which it is mounted. The single pole, double throw micro switch can be connected either to open or to close an electrical circuit when actuated. By loosening the allen screw on the actuating collar and raising or lowering the collar on the stem, the X105L is easily adjusted to signal that the valve has fully reached the desired position (open or closed).

Installation

Single Pole Double Throw Switch

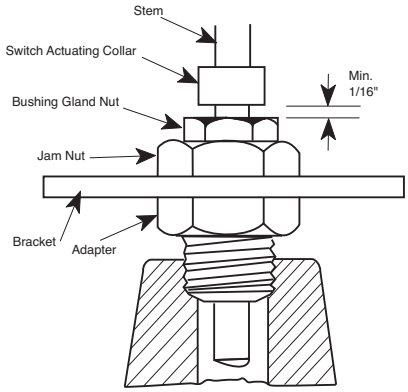


Double Pole Double Throw Switch



Switches shown in unactivated position.

1. Remove plug in top of valve cover.
2. Screw actuating stem into main valve stem.
3. Slip adapter down over stem and screw into place on valve cover.
4. Attach micro switch housing and bracket to adapter with jam nut.
5. Bring electrical supply circuit into unit through the 1/2" tapping in micro switch housing.
6. Adjust switch collars. (Set collar to trip switch after valve is positioned fully open or fully closed)



Actuating Collar Adjustment Minimum Setting

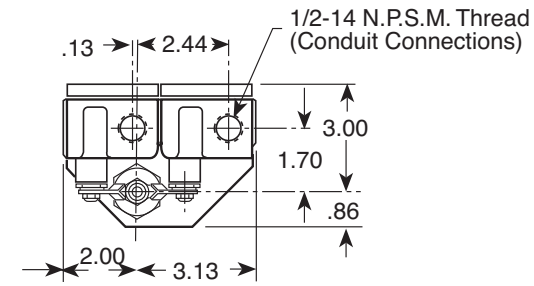
When adjusting actuating collar for proper switch action, a clearance of at least 1/16" (1/8" for 48" valve) must be provided between the collar and the bushing gland nut when valve is in the fully closed position.

Purchase Specifications

The assembly shall be bracket-mounted to exterior of an adapter attached to the center of the main valve cover. A stainless steel actuating stem with a swivel adapter shall be fastened directly to the main valve stem and move vertically through an adapter and gland with two O-ring seals as the valve moves. An adjustable collar located on the actuating stem shall actuate the sensor arm of a switch when valve has fully reached the open or closed (specify) position. The rotary-type position sensor arm shall actuate SPDT or DPDT type (specify) micro-switches mounted inside protective housing either weather-tight or explosion-proof NEMA rated (specify).

Provisions shall be made for bleeding air from valve cover through a small bleed screw and washer located on one wrench flat of adapter. All assemblies shall be capable of accommodating up to three switches. Standard materials in contact with operating fluid are brass, stainless steel, Monel and Buna-N.

A conduit hub opening in the switch enclosure shall be provided for attaching protective weatherproof conduit for the electrical switch wires (wiring and conduit supplied by others). A sealing plug shall be provided to protect conduit opening during shipping or storage.



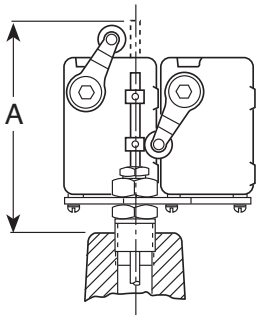


Fig. 1
Valve Size
1 1/4" Thru 8"
X105L2W
X105L2X

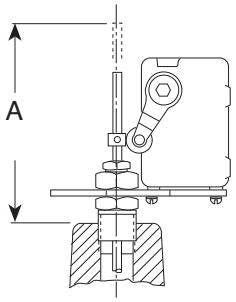


Fig. 2
Valve Size
1 1/4" Thru 14"
X105LCW
X105LCX

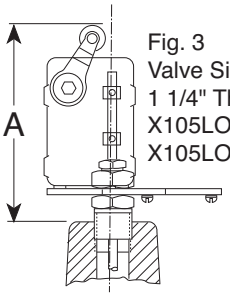


Fig. 3
Valve Size
1 1/4" Thru 8"
X105LOW
X105LOX

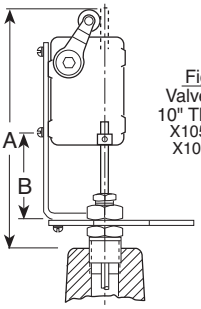


Fig. 4
Valve Size
10" Thru 14"
X105LOW
X105LOX

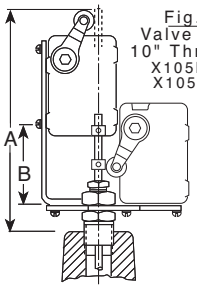
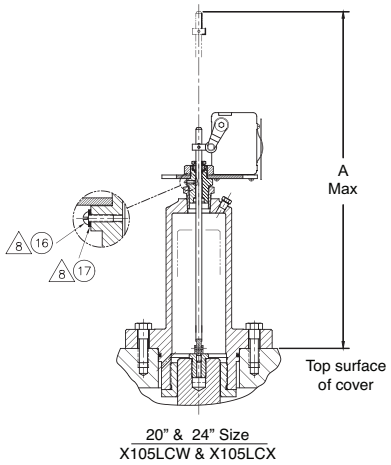
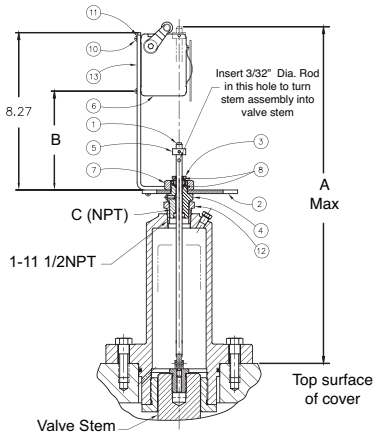


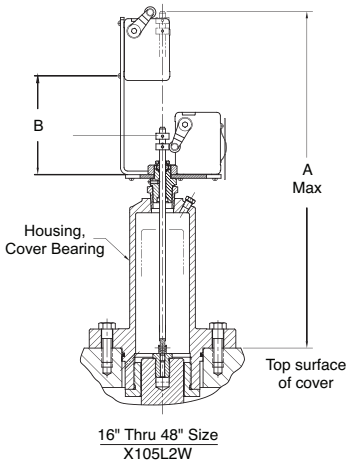
Fig. 5
Valve Size
10" Thru 14"
X105L2W
X105L2X



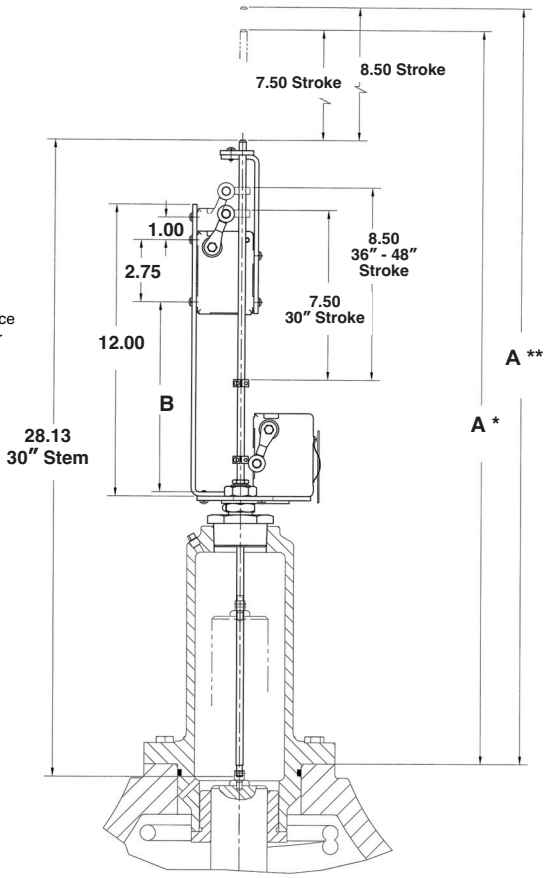
20" & 24" Size
X105LCW & X105LCX



20" & 24" Size
X105LOW



16" Thru 48" Size
X105L2W



A* - 30" • A - 36", 42" & 48" Size**

X105 Series Dimensions (In Inches)

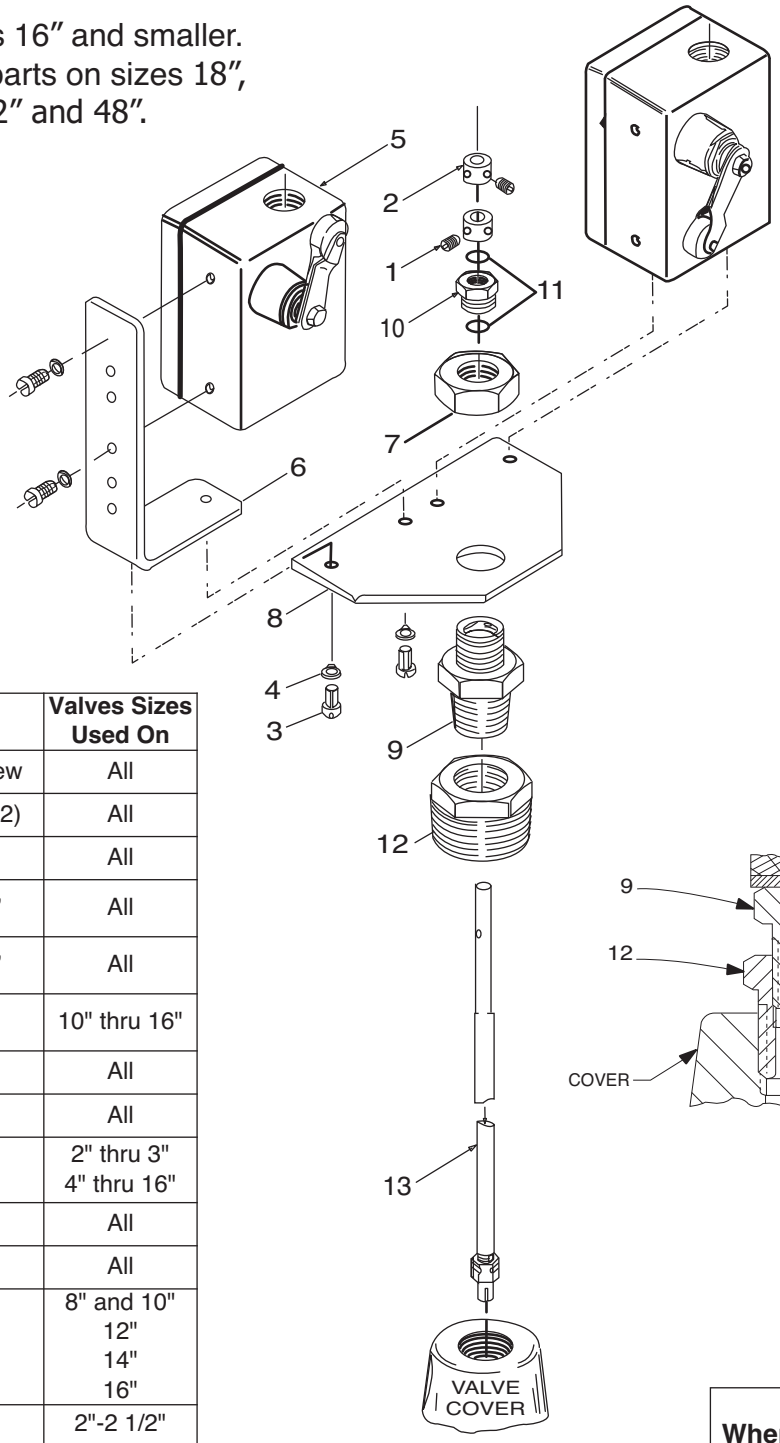
BasicValve 100-01	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24	30	36*	42*	48*
Dimension "A"	10.19	10.19	7.16	7.16	7.34	7.00	6.69	6.91	9.88	9.59	9.16	10.78	10.78	18.23	19.10	35.07	36.07	36.07	36.07
Dimension "B"							1.69	1.69	2.44	2.94	2.94	2.94	2.94	4.32	5.19	8.40	8.40	8.40	8.40
C (NPT)	1/4	1/4	1/2	1/2	1/2	3/4	3/4	1	1	1 1/4	1 1/2	2	2	3/4	3/4	2	2	2	2
BasicValve 100-20					3	4	6	8	10	12	14	16	18	20	24	30	36*	42*	48*
Dimension "A"					7.16	7.34	7.00	6.69	6.91	9.88	9.59	9.59	10.78	10.78	10.78	11.30	35.07	36.07	36.07
Dimension "B"								1.69	1.69	2.44	2.94	2.94	2.94	2.94	2.94	5.19	8.40	8.40	8.40
C (NPT)					1/2	1/2	3/4	3/4	1	1	1 1/4	1 1/4	2	2	2	1	2	2	2

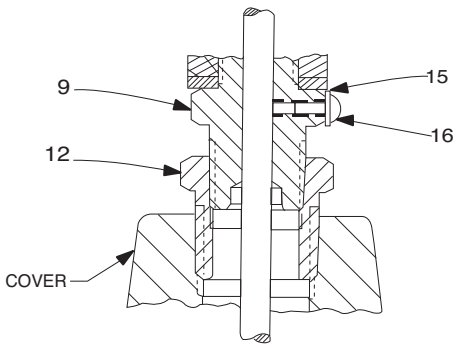
CLA-VAL

X105L

Limit Switch Assembly

Parts list shown is for sizes 16″ and smaller.
Please consult factory for parts on sizes 18″, 20″, 24″, 30″, 36″, 42″ and 48″.



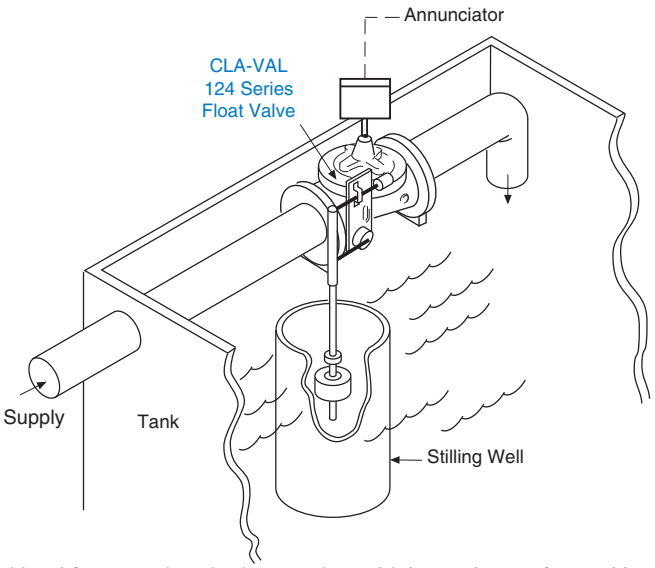


Item	Part Number	Description	Valves Sizes Used On
1-2	20441701E	Collar W/Set Screw	All
3	67578-21B	Screw, Machine (2)	All
4	67584-23F	Washer, Lock (2)	All
5	34637K	Switch Assembly, Weather Proof	All
	34633J	Switch Assembly, Explosion Proof	All
6	64310G	Bracket Switch Mounting	10" thru 16"
7	67815-06J	Nut, Jam	All
8	63674G	Plate, Mounting	All
9	2838201J 2838202G	Adapter Adapter	2" thru 3" 4" thru 16"
10	63398C	Bushing, Gland	All
11	00951E	O-Ring (2)	All
12	6764417K 6764418H 6764419F 6764491J	Bushing Bushing Bushing Bell Reducer	8" and 10" 12" 14" 16"
13	8970101F 8970102D 8970103B 8970104K 8970105G	Stem, Actuating Stem, Actuating Stem, Actuating Stem, Actuating Stem, Actuating	2"-2 1/2" 3"-4" 6"-8" 10"-12"-14" 16"
15	6551201H	Fiber Washer	All
16	6824421K	Screw 8-32 x 3/8	All

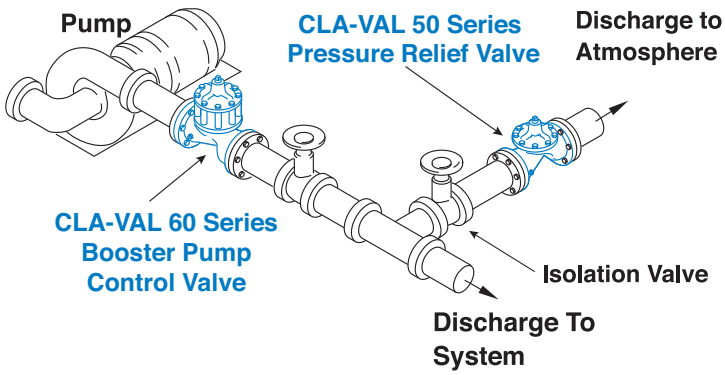
When ordering parts, please specify:

- Item Number
- Description
- Part Number

Typical Applications



Used for any electrical operation which can be performed by either opening or closing a switch; such as alarm systems, process control, pump control, motor starting or stopping, etc. Readily attached to most Cla-Val Valves.



The X105L Series Limit Switch Assembly is used on Cla-Val 60 Series Booster Pump Control Valves. Flexible conduit is used for electrical connections to the solenoid control and the limit switch.

Specifications

Materials:	Aluminum switch housing Steel bracket and brass adapter Stainless steel stem
Electrical:	1/2" Conduit connection
Switch Type:	SPDT UL, File No. E12252, CSA Certified, File No. LR57325 Weather proof NEMA 1,3,4, and13
Switch Rating:	UL/CSA rating: L96 15 amp. 125, 250, or 480 volts AC 1/2 amp. 125 volts DC 1/4 amp. 250 volts DC
Switch Options:	DPDT switches available on request UL/CSA Rating: L59, 10 amps Explosion proof micro switches are NEMA 1,7, and 9 UL Listed, File No. E14274 and CSA Certified, File No. LR57324: Class I, Group C and D and Class II, Group E, F and G.

When Ordering, Please Specify

1. Valve Size and Basic Valve Model Number
2. Catalog Number from Table Below
3. All Valve Name Plate Data
4. Select Single or Double Pole Switch
5. Explosion Proof or Weather Proof Type Enclosure
6. Amperes and Voltage, AC or DC
7. Actuating Position (Valve Open or Closed)

CATALOG NO.	ACTUATION POSITION	SWITCH ENCLOSURE
X105LCW	Valve Closed	Weather Proof
X105LCX	Valve Closed	Explosion Proof
X105LOW	Valve Open	Weather Proof
X105LOX	Valve Open	Explosion Proof
X105L2W	Dual	Weather Proof
X105L2X	Dual	Explosion Proof

CLA-VAL

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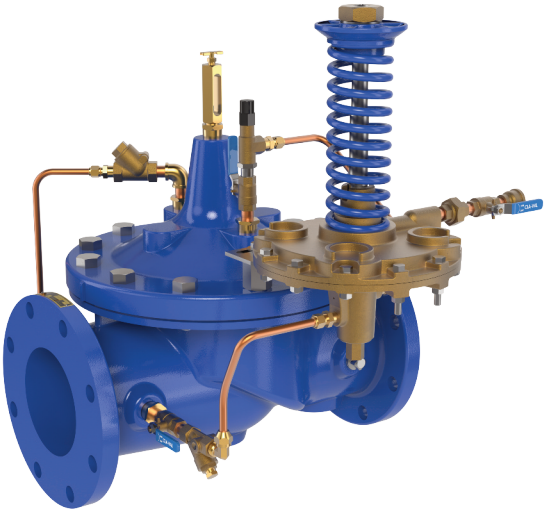
CLA-VAL™

MODEL 610-16

Altitude Valve For Two-Way Flow



- **Accurate and Repeatable Level Control**
- **Drip-Tight Positive Shut-Off**
- **Reliable Hydraulic Operation**
- **Easily Adjustable Control**
- **Completely Automatic Operation**

The Cla-Val Model 610-16 Altitude Valve controls the high water level in reservoirs without the need for floats or other devices. It is a non-throttling valve that remains fully open until the shut off point is reached. This valve closes at a high water level, and opens for return flow when the pressure at the valve inlet is less than the reservoir pressure.

This valve is hydraulically operated and pilot controlled. The pilot control operates on the differential in forces between a spring load and the water level in the reservoir. When the force of the spring is overcome by the force of the reservoir head, the pilot closes the main valve. The desired high water level is set by adjusting the spring force. The pilot control measures the reservoir head through a customer supplied sensing line* connected directly to the reservoir.

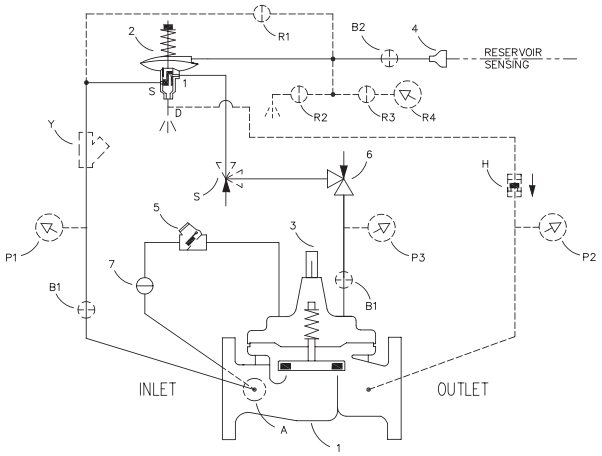
This valve can also be furnished with auxiliary controls to meet the need for multiple functions, such as: pressure sustaining, pressure reduction, rate of flow control, solenoid override, etc.

Schematic Diagram

Item	Description
1	100-20 Hytrol Main Valve
2	CDS6A Altitude Control
3	X101 Valve Position Indicator
4	Bell Reducer
5	Check Valve
6	CV Flow Control (Closing)
7	CK2 Isolation Valve

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 Isolation Valve
H	Dry Drain
P	X141 Pressure Gauge
R	Reservoir Gauge with Tester
S	CV Flow Control (Opening)
Y	X43 "Y" Strainer



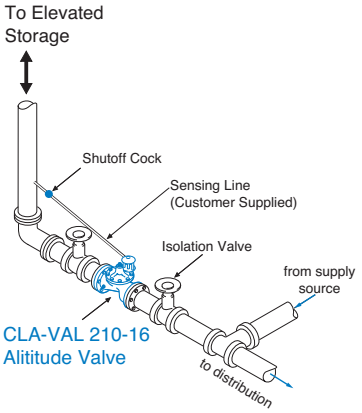
Typical Applications

Used on reservoirs where water is withdrawn through the Altitude Valve. The valve closes at the high water level and opens for return flow when the pressure at the valve inlet lowers below the reservoir pressure.

For more information see data sheet E-CDS6A

*Note: The reservoir pressure sensing line should be ¾" minimum I.D. installed with a 2° slope from valve to reservoir to avoid air pockets.

We recommend protecting tubing and valve from freezing temperatures.



Model 610-16 (Uses Main Valve Model 100-20)

Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class		
		Flanged		
Grade	Material	ANSI Standards*	150 Class	300 Class
ASTM A536	Ductile Iron	B16.42	250	400
ASTM A216-WCB	Cast Steel	B16.5	285	400
UNS 87850	Bronze	B16.24	225	400

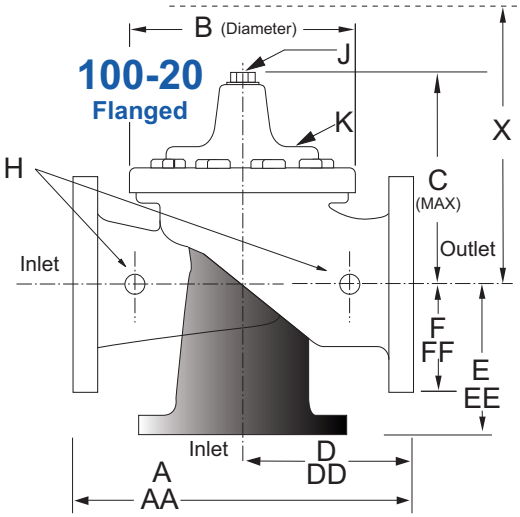
Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
Valves for higher pressure are available; consult factory for details

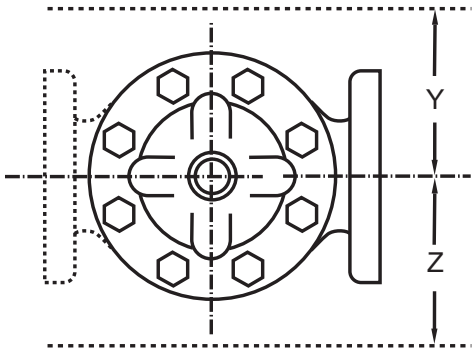
Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	3" - 48" 80 - 1200 mm	3" - 16" 80 - 400 mm	3" - 16" 80 - 400 mm
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		

For material options not listed, consult factory.
Cla-Val manufactures valves in more than 50 different alloys.

Dimensions (In inches)





Cover Capacity

Liquid Volume Displaced from Diaphragm Chamber When Valve Opens or Closes

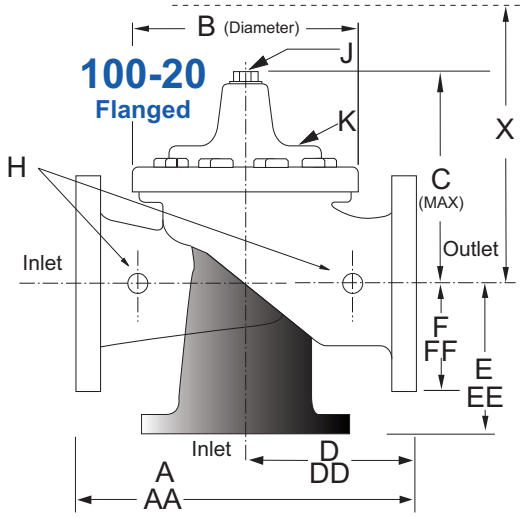
Valve Size	Displace-ment
3"	.032 gal
4"	.080 gal
6"	.169 gal
8"	.531 gal
10"	1.26 gal
12"	2.51 gal
14"	2.51 gal
16"	4.00 gal
18"	4.00 gal
20"	9.57 gal
24"	9.57 gal
30"	29.00 gal

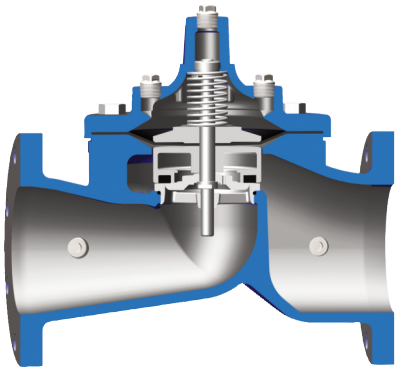
Model 610-16 Dimensions (In Inches)

Valve Size (Inches)	3	4	6	8	10	12	14	16	18	20	24	30	36	48
A 150 ANSI	10.25	13.88	17.75	21.38	26.00	30.00	34.25	35.00	42.12	48.00	48.00	63.25	65.00	88.0
AA 300 ANSI	11.00	14.50	18.62	22.38	27.38	31.50	35.75	36.62	43.63	49.62	49.75	63.75	67.00	90.62
B Diameter	6.62	9.12	11.50	15.75	20.00	23.62	27.47	28.00	35.44	35.44	35.44	53.19	56.00	66.00
C Maximum	7.00	8.62	11.62	15.00	17.88	21.00	20.88	25.75	25.00	31.50	31.50	43.94	54.75	59.00
D 150 ANSI	—	6.94	8.88	10.69	CF*	17.00	CF*	CF*	CF*	CF*	21.06	—	—	—
DD 300 ANSI	—	7.25	9.38	11.19	CF*	17.75	CF*	CF*	CF*	CF*	CF*	—	—	—
E 150 ANSI	—	5.50	6.75	7.25	CF*	13.75	CF*	CF*	CF*	CF*	15.94	—	—	—
EE 300 ANSI	—	5.81	7.25	7.75	CF*	14.75	CF*	CF*	CF*	CF*	CF*	—	—	—
F 150 ANSI	3.75	4.50	5.50	6.75	8.00	9.50	11.00	11.75	15.88	14.56	17.00	19.88	25.50	34.00
FF 300 ANSI	4.12	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.88	16.06	19.00	22.00	27.50	38.50
H NPT Body Tapping	0.375	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
J NPT Cover Center Plug	0.50	0.50	0.75	0.75	1.00	1.00	1.25	2.00	2.00	2.00	2.00	2.00	2.00	2.00
K NPT Cover Tapping	0.375	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
Stem Travel	0.60	0.80	1.10	1.70	2.30	2.80	3.40	4.50	4.50	4.50	6.50	7.50	7.50	8.50
Approx. Ship Weight (lbs)	45	85	195	330	625	900	1250	1380	2365	2551	2733	6500	8545	13100
Approx. **X** Pilot System	13	15	27	30	33	36	36	41	40	46	55	68	79	86
Approx. **Y** Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	40	47
Approx. **Z** Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	42	49

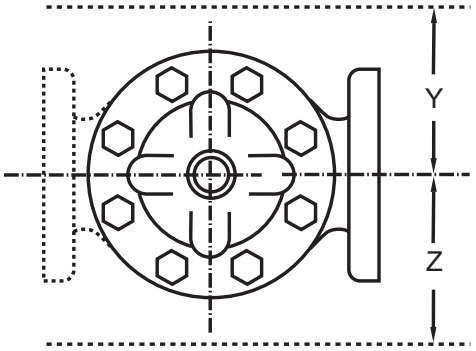
*Consult Factory

Model 610-16 Metric Dimensions (Uses Main Valve Model 100-20)





Model 100-20 Reduced Port Hytrol Main Valve



610-16 Dimensions (mm)

Valve Size (mm)	**80**	**100**	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**600**	**750**	**900**	**1200**
A 150 ANSI	260	353	451	543	660	762	870	889	1070	1219	1219	1607	1651	2235
AA 300 ANSI	279	368	473	568	695	800	908	930	1108	1260	1263	1619	1702	2302
B Diameter	168	232	292	400	508	600	698	711	900	900	900	1351	1422	1676
C Maximum	178	219	295	381	454	533	530	654	635	800	800	1116	1391	1499
D 150 ANSI	—	176	226	272	CF*	432	CF*	CF*	CF*	CF*	535	—	—	—
DD 300 ANSI	—	184	238	284	CF*	451	CF*	CF*	CF*	CF*	CF*	—	—	—
E 150 ANSI	—	140	171	184	CF*	349	CF*	CF*	CF*	CF*	405	—	—	—
EE 300 ANSI	—	148	184	197	CF*	368	CF*	CF*	CF*	CF*	CF*	—	—	—
F 150 ANSI	95	114	140	171	203	241	279	289	403	370	432	505	648	864
FF 300 ANSI	105	127	159	191	222	260	292	324	403	408	483	559	699	978
H NPT Body Tapping	0.375	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
J NPT Cover Center Plug	0.50	0.50	0.75	0.75	1.00	1.00	1.25	2.00	2.00	2.00	2.00	2.00	2.00	2.00
K NPT Cover Tapping	0.375	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
Stem Travel	15	20	28	43	58	71	86	86	114	114	114	165	191	216
Approx. Ship Weight (kgs)	20	39	89	150	284	409	568	627	681	1157	1249	2951	3876	5942
Approx. **X** Pilot System	331	381	686	762	839	915	915	1042	1016	1169	1397	1728	2007	2185
Approx. **Y** Pilot System	254	280	458	508	559	610	661	661	762	762	762	991	1016	1194
Approx. **Z** Pilot System	254	280	458	508	559	610	661	661	762	762	762	991	1067	1245

*Consult Factory

610-16 Valve Selection	100-20 Pattern: Globe (G), Angle (A), End Connections: Flanged (F) Indicate Available Sizes															
	Inches	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
	mm	80	100	150	200	250	300	350	400	450	500	600	750	900	1000	1200
Main Valve 100-20	Pattern	G	G, A	G, A	G, A	G	G	G	G	G	G	G	G	G	G	G
	End Detail	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	260	580	1025	2300	4100	6400	9230	9230	16500	16500	16500	28000	33500	33500	33500
Suggested Flow (Liters/Sec)	Maximum	16	37	65	145	258	403	581	581	1040	1040	1040	1764	2115	2115	2115

100-20 Series is the reduced internal port size version of the 100-01 Series.

Pilot System Specifications

Adjustment Ranges

5 - 40 ft.
30 - 80 ft.
70 - 120 ft.
110 - 160 ft.
150 - 200 ft.

Temperature Range

Water: to 180°F

If flowing line pressure is less than 10 psi, consult factory for full details.

If inlet pressure is above 150 psi, consult factory for recommendations.

Materials

Standard Pilot System Materials

Pilot Control: Low Lead Bronze
Trim: Stainless Steel Type 303
Rubber: Buna-N® Synthetic Rubber

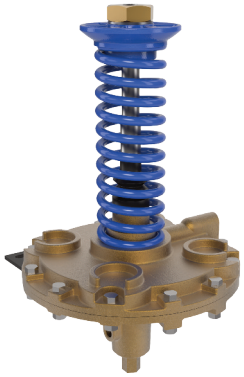
Optional Pilot System Materials

Pilot Systems are available with optional Aluminum, Stainless Steel, or Monel materials. Valve position indicator is standard

When Ordering, Specify:

1. Catalog No. 610-16
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Threaded or Flanged
6. Materials Desired
7. Adjustment Range
8. Desired Options
9. When Vertically Installed

Altitude Pilot Control Overview



- **Very Accurate and Reliable**
- **Low Maintenance**
- **Bronze and Stainless Steel Wetted Parts**

The Cla-Val Model CDS6A Altitude Pilot Control is a spring-loaded, three-way, diaphragm-actuated control that provides high-level shutoff for Cla-Val 610 Series Altitude Control Valves. The CDS6A controls the high water level in a reservoir or tank without the need for floats or other devices. It is a non-throttling pilot that remains fully open until the reservoir reaches the high level shutoff point. High accuracy is assured by remotely sensing the pressure head of the reservoir or tank. The single adjusting nut can be easily set in the field to close the main valve when liquid level reaches the desired high level set-point within five adjustment ranges.

The CDS6A operating principle uses a differential in forces between the spring load and the hydraulic head of the fluid level in the reservoir or tank to activate the pilot valve of the control. When the force of the spring setting (or the desired high level shutoff point) is overcome by the force of the reservoir head, the pilot valve shifts positions automatically and closes the main valve. When the reservoir head is eight to ten inches less than the spring setting, the pilot valve shifts to open the main valve.

For a comprehensive overview of Cla-Val Altitude Control Valves, please vist www.cla-val.com and use. keyword search "Altitude".

CLA-VAL
1701 Placentia Avenue • Costa Mesa, CA 92627
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visit www.cla-val-latinamerica.com for Spanish literature

Appendix G: Chloramination System

JCS Industries Inc.

PO Box 90028
Houston, TX 77290-0028
Phone: 281-353-2100
Fax: 281-353-0657
www.jcsindustries.us.com

Project: UTMB Elevated Storage Tank
Engineer: Kimley-Horn
Date: 9/22/23
Section: Chemical Feed Equipment

Qty:	Equipment:
2	JCS Model 420-VRC-CL Cylinder Mounted Vacuum Regulator, Cl2
2	JCS Model 420-MRMT 0-100
2	JCS Model 420-INJ-12 Injectors
1	JCS Model 4500-D-CL Dual Channel Leak Detector, Cl2
1	Dual Cylinder Scale
2	JCS Model RC150 Emergency Shutoff Valves
1	JCS Model RCP006RCC Control Panel
1	JCS Model RPB001 Remote Panic Button
2	Solenoid Valve
1	Wye Strainer
1	Pressure Gauge
2	Booster Pump
1	Checmical Solution Diffuser
1	30 Min. SCBA
1	SCBA Wall Case
1	Lot Ammonia
1	Lot Cylinder Saftey Chain

LAS

2	JCS Model 4100 Liquid Vacuum Feeders
2	484x Vacuum Injector
1	250 gal DW Day Tank
1	Checmical Solution Diffuser
1	Model 4600-L Ultrasonic Level Indicator
1	Danger LAS Placard
1	Safety Shower/Eyewash Station
1	Swan Codes CC
1	Swan AMI Ammonia Universal
1	Pressure Reducing Valve
1	Pressure Gauge

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1	Lot Install
1	Lot Startup
1	Lot Submittal and O&M Documents
1	Lot Misc Sch 80 PVC Pipes, Valves & Fittings

Cl2 Cost: $44,410.00
LAS Cost: $32,270.00
Analyzer Cost: $19,535.00
Total Proposed Cost: $96,215.00

Respectfully Submitted by: Scotty Whitmore

Exclusions: Wall Penetrations, Startup Chemical, Concrete, Yard Piping, Electrical, Control Switches, Pipe Taps, Insulation, Heaters, and Earth Work.

Please note, this bid is for the above listed equipment ONLY

JCS Industries Inc.

Innovative Chemical Feed Solutions

Model 420-C Vacuum Regulator

The JCS Industries Model 420-Cylinder Mounted Regulator is designed for years of safe and reliable service.

This robust design includes a machined front and back body, internal (non-latching) switching mechanism, internal pressure relief vent and a non-metallic inlet valve assembly. The Model 420-C Vacuum Regulator is direct cylinder mounted or can be installed on multiple cylinder pressure headers.

The JCS Model 420-C operates as a pressure reducing valve to transfer gas under pressure to gas under vacuum within the chemical feed system.

Installed between the cylinder of the chosen gas and the Chemical Feeder Model 4200, the Model 420 will switch from one cylinder to the next one in line as soon as the gas in the first cylinder is depleted. An internal switchover valve is automatically activated in the event of gas supply failure; the reduction of the vacuum will isolate the regulator diaphragm cavity from pressurized pipe work.

-Rate Range: 1 to 500 PPD

-Shuts off the gas supply in the event of vacuum failure

-Durable components

-Provides an indication of gas supply status

-Does not require an auxiliary pressure reducing valve

-Suitable for chlorine, sulfur dioxide or ammonia gas

-Unit includes an internal switchover valve

-Cylinder or yoke mounting capability

-Low part count construction for low maintenance

A LIQUA FLOW PRODUCT

Ph: 281-353-2100
Fax: 281-353-0657
PO Box 90028
Houston, TX 77290
www.jcsindustries.us.com

Technical Specifications Model 420-C

Range	1 to 500 Lbs. Per Day
Chemical of Use	Cl2, SO2, NH3
Mounting Assemblies	150 lb. Cylinder or Yoke
Internal Switchover Valve	Yes
Connections	Vacuum to injector - 0.375" FNTP Vent to outside - 0.375" FNPT
Overal Dimensions	4.625" L x 5.125" W x 5.125" H
Weight	6 Lbs.

Characteristics

JCS Industries 420-C Vacuum Regulator regulates the supply of pressurized chlorine, sulfur dioxide or ammonia gas into a vacuum dosing system at a rate of up to 500PPD.

The regulator consists of: a sealed cavity, diaphragm with opposing return spring, gas inlet valve, vacuum outlet, high pressure vent and vacuum status indicator.

In the event of high vacuum caused by gas supply failure, the regulator will seal off the vacuum from the supply.

In the event of vacuum failure, the return spring safely shuts off the gas supply inlet valve. If gas pressure occurs in the vacuum cavity, it will be vented safely to an external atmosphere.

JCS Industries Inc.

Innovative Chemical Feed Solutions

Model 420-INJ Injector

The JCS Industries Model 420 INJ Chemical Injector is designed to easily and safely deliver chemical into the water supply using an existing water line.

The Model 420 INJ Chemical Injector operates using vacuum by utilizing the venturi effect, which is a byproduct of water flow though the system. The injector will only function when there is sufficient water pressure in the unit and will only function when the system is operating.

Range	1 to 100 Lbs. Per Day
Chemical of Use	Cl2, SO2, NH3, NaOCl, LAS, CLO2, C2H4O3
Nozzle Dimensions	3/4" NPT
Connections	1/2" NPT
Operating Pressure	12 to 19 inHg
Operating Back Pressure	Up to 140 Psi
Overal Dimensions	9" x 5" x 3.5"
Weight	2.5 Lbs.

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JCS Industries Inc.

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Model 420-RMT & MRMT Remote Meter Panel

The JCS Industries Model 420 Remote/ Mini-Remote Meter Panel is designed to safely deliver and meter gaseous chemical from the vacuum regulator to the injector. Both the remote meter and the mini-remote meter assemblies are designed to precisely deliver chemical over months at a time without service.

Range	420-RMT: 0-1500 PPD 420-MRMT: 0-250 PPD
Chemical of Use	Cl2, SO2, NH3
Rotameter Sizes	10, 25, 50, 100, 250, 500 1000, 1500 PPD
Connections	3/4" to 1-1/4" NPT
Acurracy	± 4% of Full Scale
Overal Dimensions	420-RMT: 12" x 3.5" x 4" 420-MRMT: 7.5" x 3" x 1.25"
Weight	420-RMT: 3 Lbs. 420-MRMT: 1/2 Lbs.

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Houston, TX 77290
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JCS Industries Inc.

Innovative Chemical Feed Solutions

Model 4500 Gas Leak Detector/Monitor

The JCS Industries Model 4500 Gas Leak Detector/Monitor is a low cost, non-contact and easy to install measurement device designed for monitoring trace amounts of compressed gaseous water treatment chemicals such as, but not limited to: chlorine, sulfur dioxide and ammonia in a closed or open environment.

This unit monitors toxic suspended molecules in the atmosphere. In a leaking scenario, the Model 4500 activates an alarm when gas levels exceed the programmed maximum rates.

The monitoring sensors are compact and are designed for unobtrusive wall mounting in any convenient position. Installation, commissioning and maintenance are simplified by the modular design of the electronics.

The model 4500 can monitor up to two different gases simultaneously with each main controller.

- **Electro-chemical sensors**
- **Durable components**
- **IP 66,67 enclosures**
- **Available for Cl2, SO2, NH3 and other gases**
- **Low Maintenance**
- **Provides both local and remote alarms**
- **Typical Ranges:**
  - **0-10ppm**
  - **0-30ppm**
  - **0-100ppm**

LIQUA FLOW PRODUCT

Ph: 281-353-2100
Fax: 281-353-0657
PO Box 90028
Houston, TX 77290
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Technical Specifications Model 4500

Range	Selectable 0 - 100 PPM
Accuracy	+/- 0.5% of span
Power Supply	110/220 VAC, 50/60 Hz
Repeatability	+/- 0.25%
Enclosure	IP 66,67
Operating Temperature	-20 degrees F to +125 degrees F
Signal Cable	#18-3 wire 2 conductor shielded cables
Display	Backlit LCD 16 characters X 2 lines
Alarm Relays	Two adjustable set points with 5Amp SPST-independently adjustable relays configured for high and low alarm
Outputs	4-20mA, 0-500 ohm RS232C
Dimensions (Controller)	6 L x 9.5 W x 7.7 H
Dimensions (Sensor)	4 L x 5 W x 5 H
Weight (Controller)	7 Lbs.
Weight (Sensor)	1 Lbs.

Characteristics

The Model 4500 system is comprised of a control unit and one or two remote gas sensing heads. Clear indication of gas level is given by a back-lit LCD display which provides a reading from each detector. Monitoring is carried out continuously. Each channel's reading can also be manually selected.

Channel identification is continuous and is provided on the LCD display. In the event of a detector sensing at a concentration higher than the alarm set point, the LCD displays the level and the back-light flashes as well as triggers the prospective alarm. For interfacing the Model 4500 with computers, recorders, telemetry, etc., outputs are provided to give isolated 4-20mA, 0-500ohm signals and RC 232 communications.

JCS Industries Inc.

Innovative Chemical Feed Solutions

Model 4700 Electronic Cylinder Scale

The JCS Industries Model 4700 Electronic Cylinder Scale is designed for years of safe, continuous use for weighing 150 pound compressed gas cylinders. The non-corroding, high impact resistant plastic scale base allows for ease of loading. The Model 4700 scale also incorporates a bolt secured base, which restricts movement of the plate increasing it's longevity. The Model 4700 can be set up for single or dual cylinder operation with independent analog outputs as well as adjustable outputs for accurate and reliable operations.

- **Corrosion resistant "bolt secured base"**
- **Electronic load cell eliminates temperature related drift**
- **Robust design**
- **4-20mA DC outputs**
- **Four adjustable relays**
- **Data logger**
- **Dependable lever style weight system**

A LIQUA FLOW PRODUCT

Ph: 281-353-2100
Fax: 281-353-0657
PO Box 90028
Houston, TX 77290
www.jcsindustries.us.com

Technical Specifications Model 4700

Power Supply	110/220 VAC 50/60 Hz
Display	Backlit LCD 16 characters X 2 lines
Enclosure	IP 66,67
Relays	4-5Amp 110 VAC / 3 Amp 220 VAC
Buzzer	103 dB
Analog Input	2- isolated 4-20 mA, 650 ohm load, active
Resolution	0.1 Lbs.
Capacity	360 Lbs. per platform
Data Logger	RS-232
Dimensions (Controller)	6" L x 9.5" W x 7.75" H
Weight (Controller)	6 Lbs.
Dimensions (Platform)	31" L x 18" W x 1.6" H
Weight (Platform)	28 Lbs.

Characteristics

The dual cylinder scale is a strain gauge with an electronic read out. The scale platform is constructed out of a non-corrosive, high impact plastic with a maximum height of 1.6 inches from the floor to bottom of the cylinder platform. The controller independently monitors the total or remaining weights of each cylinder. The cable length is 15 feet with ability to extend up to 100 feet in length. The cylinder back support includes a double loop coil chain and spring loaded snap hook to help contain and steady the cylinder. The scale transmits the remaining cylinder weight via a 4-20mA DC signal.

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Innovative Chemical Feed Solutions

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Enclosure	NEMA 4X
Battery	12/24V SLA 7AH
Charger	120/240 VAC, 1 AMP
Indicator	Automatic 4 LED's
Inputs	Close from remote contact RF open/close from RCP
Remote	Battery and charger (RPC) control enclosure with transceiver
Rotation	Programmable up to 360 degrees
Materials	Polycarbonate, stainless steel, steel, brass & RF Nylon
Actuator wt.	6 lbs
Torque	40ft/lb
Compatibility	Chlorine Institute 110 and conforms to CI Publication

"RECOMMENDED FOR EMERGENCY CLOSURE DEVICES FOR CONTAINER VALVES"

Model RC
Actuator

OPERATION
The Model RC is an actuator that OPENS AND CLOSES the valve on compressed gas cylinders such as chlorine, sulfur dioxide, and ammonia cylinders and containers. The actuator is battery operated with an electric motor that rotates the valve stem toward open or closed position for alignment, tests, and remote operation. The actuator is designed to mount without interfering with cylinder mounted hardware such as chlorinators, regulators etc. No yoke modifications or additional adapters are required. The motor, gears, and controls are assembled as one unit.

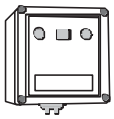
CAPABILITIES
- Battery operated with automatic charger
- No large signal cables
- Remote control by leak detector, panic button or other digital signals such as PLC or computer
- Easily attaches to valve
- Can be used on chlorine, sulfur dioxide and ammonia 150# cylinders and ton containers
- Eliminates the need for scrubbers in certain applications per the Uniform Fire Code

FEATURES
The system includes a remote power supply enclosure for trickle charge of the SLA battery. Engaging the actuator is accomplished by tilting the actuator, resting actuator on valve and repositioning to the same plane as the valve stem. Monitor and controls are accomplished with a microprocessor and integral LED lights for CLOSED, ALIGN, and OPEN. Setup is accomplished through an integral keypad. Valve position is transmitted to the microprocessor from a direct-coupled potentiometer.

ADDITIONAL INFO
For information on more actuators that open and close ton cylinders, refer to Specification Model 2000C and Model U.

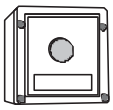
SYSTEM COMPONENTS
The Model RC actuator is packaged as an independent actuator that opens and closes the cylinder or container valve by using an integral membrane keypad. The actuator mounts to the valve independently from any hardware that may be mounted to the valve. A 30-foot, 4- wire shielded signal cable is included with an AMP connector that attaches to the actuator. The loose end of the cable is terminated in the Model RPS006 or RCP006RC for battery power and a close signal that is created by a remote contact from another device, such as a leak detector or panic button. The enclosure body can be rotated on the actuator base by 180 degrees to accommodate mounting two actuators on a ton container simultaneously. The gear drive alignment arm can be rotated in 90 degree increments to accommodate various mounting requirements. The Model RC shipping carton is 12" x 6" x 6", weighs 8 pounds, and includes actuator, 30-foot cable, storage bracket and instruction book.

ACCESSORIES



JCS MODEL 4500

The **JCS Model 4500** is a remote leak detector and is powered by a 120/240 source. The leak detector has a contact closure that will close all actuators if the ambient air contains chlorine or sulfur dioxide. Alarm points are adjustable in increments of 1 PPM from 1 to 10 PPM. The enclosure is NEMA 4X and includes a 4-20mA output, a power light, alarm light and acknowledge pushbutton to clear the output contact closure. Mounting holes and cable entries are created by the installer. The Model JCS 4500 weighs 2 pounds. The leak detector and instruction book are included.



MODEL RPB001

The **Model RPB001** is a remote pushbutton that can be used to close all actuators. It has one dry contact that can be connected to the LD terminals of the RPS006 or RCP006RC. Mounting holes and cable entries are created by the installer. The Model RPB001 with shipping carton is 7" x 7"x 7" and weighs 2 pounds.

MODEL RCP006RC

The **Model RCP006RCC** is an optional control panel for Model RC actuators. This control panel has battery for Model RC, optional second battery for leak detectors, charger, and terminals for six actuators. The enclosure includes a power light, input/output isolation relay, and panic button for operator interface. As an option, this control panel can supply power for up to 12 Model RC actuators. The Model RCP006RCC with shipping carton is 24" x 18" x 12" and weighs 26 pounds.

LK006 - U Clip Retainer required for each actuator on ton containers
BA012-7 - Spare Battery -12 Volts 7AH
BA012-5 - Spare Battery -12 Volts 5AH

by: JCS Industries Inc.

JCS Industries Inc.

Innovative Chemical Feed Solutions

Model 4100 Liquid Vacuum Chemical Feeder

The JCS Industries Model 4100 Liquid Vacuum Chemical Feeder is for operations that require high efficiency, accuracy, control and safety. The Model 4100 will feed numerous aqueous chemicals commonly used in municipal and industrial water treatment systems, i.e, sodium hypochlorite, sodium bisulfate, aluminum sulfate, ammonium sulfate, acids, sodium hydroxide, non-oxidizing biocides, scale and corrosion inhibitors.

The system is comprised of a vacuum injector to safely introduce the liquid into the feed-water stream. A reversing servo motor coupled with a V-notch valve to regulate the chemical feed rate, an electronic flow sensor to monitor and regulate the feed rate and a control module for complete electronic control and communications.

The JCS Model 4100 Liquid Feeder will automatically regulate in both fixed and variable control modes.

Control Modes:

- -Fixed Feed Rate
- -Flow Paced
- -Residual Control
- -Compound Loop

-Wide flow range: 0 to 12,000 GPD

-Turn down ratio of 100:1

-High accuracy: +/- 2% of actual feed

-System Flexibility: four control modes

-Battery Backup: > 2.5 hours of backup

-Programmable microprocessor

-No air binding possible

-Metering to validate actual flow rate

-Multiple failure mode alarms

-On-board Totalizer

Patent: US 7,776,275

A LIQUA FLOW PRODUCT

Ph: 281-353-2100
Fax: 281-353-0657
PO Box 90028
Houston, TX 77290
www.jcsindustries.us.com

Technical Specifications Model 4100

Range			5% to 400% in 0.01% increments 0 to 12,000 GPD
Accuracy			+/- 2% of actual feed rate
Power Supply			110/220 VAC, 50/60 Hz
Battery Backup			12 VDC, 2.5 Amp Hours
Operating Temperature			32°to 120°F
Enclosure Protection			IP 66,67
Display			Backlit LCD 16 characters X 2 lines
Connections	Inlet & Outlet		1/2" FNPT
Inputs	Flow, Residual Chlorine		4-20mA DC
	Remote Start & Stop		Volt Free
Outputs	Chemical Feed Rate		4-20mA DC
	System Failure		Power supply, chemical feed drive motor and set point-all volt free.
Dimensions (Including Wall Mounted Panel)			7 " L x 12" W x 33" H
Weight			32 Lbs

Characteristics

The plant's water flow rate and/or a chemical residual signal shall be used to adjust the disinfection chemical liquid flow rate by electronically positioning the servo motor driving the feed control valve. The ratio of input signal to liquid flow is adjustable over a range of 5% to 400% to enable increased liquid feed in response to additional chemical demand. Where compound loop control is required, the model 4100 controller will receive two analog signals and feed to a user defined set point without the need for an additional PID controller. A compound loop with a second trim signal and remote control signal must be included. A provision is available for user adjustment of flow and residual dynamics factor to ensure accuracy of dosage control. In the automatic or manual mode, output relay contacts will provide the means for alarm and control functions. All relays are to be user selectable as normally open or normally closed. A 4-20mA output signal of the actual chemical feed rate is supplied.

JCS Industries Inc.

Innovative Chemical Feed Solutions

Model 4600 Ultrasonic Level / Flow Monitor

The JCS Industries Model 4600 Ultrasonic Level / Flow Monitor is designed to provide accurate and reliable level and flow rate measurements in the treatment process where harsh environments exist.

The Model 4600 can easily be configured for bulk chemical storage tanks providing a continuous level or volume readout, or in an open channel environment where a calculation can be entered to the monitor to display and totalize flow.

The Model 4600 has internal data logging capability to aid in determination of trend and other important data for use in process diagnostics.

- **-Non contacting ultrasonic operation**
- **-Level and flow monitoring**
- **-Rugged compact design**
- **-Ease of operation and setup**
- **-Up to 1,000 foot separation**
- **-8 digit intergral totalizer**
- **-Data logger**

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Power Supply	110/220 VAC 50/60 Hz
Display	Backlit LCD 16 characters X 2 lines
Range	0 to 16.0 Feet (12" dead band)
Accuracy	+/- 0.25%
Separation	Up to 1000 ft
Relays	5A SPD 110/ 3A SPD 220
Buzzer	103dB
Analog Output	Isolated 4-20mA, 0-650 ohm load, active
Digital Output	RS232
Dimensions	6" L x 9.5" W x 7.75" H
Weight	8 Lbs.

Characteristics

The non-contacting ultrasonic level/flow monitor is housed in a corrosion resistant IP 66,67 enclosure and is capable of measuring the liquid level in a closed tank and open channel environments. The monitor controller will be field adjustable with no external devices and will incorporate password protection for all configuration data. The monitor will include (4) hi/low relay contacts with adjustable status. The monitor can accommodate a built-in data logger via RS-232 connection.

SWAN Analytische Instrumente AG
CH-8340 Hinwil/Switzerland
Tel. +41 44 943 63 00
swan@swan.ch · www.swan.ch

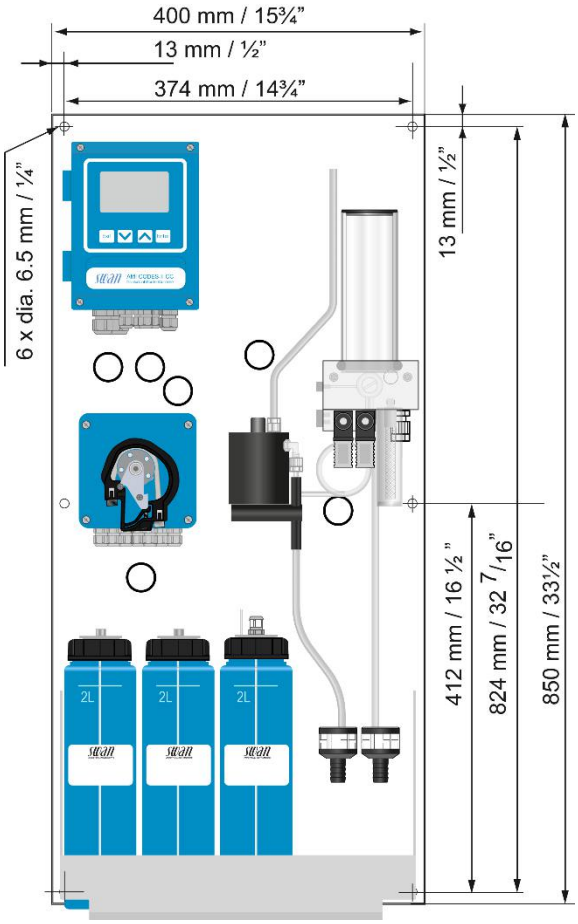
Monitor AMI Codes-II CC

Data sheet no. DenA2544X7000

Complete monitoring system for the automatic, continuous measurement of free chlorine, monochloramine, total residual chlorine and combined chlorine in potable water, sanitary water and effluent.

Monitor AMI Codes-II CC

- For the continuous online determination of disinfectants based on the DPD colorimetric method (EN ISO 7393-2; APHA 4500-Cl G).
- Measurement values : free chlorine, monochloramine, total residual chlorine, combined chlorine, flow and if installed pH and temperature.
- Also applicable for water containing additives like cyanuric acid.
- Complete system including measurement and control electronics, photometer, flow indicator, reaction chamber, reagent dosing system and reagent containers.
- Integrated pH measurement with temperature compensation (available as option).
- All usual dosing devices for disinfectants and pH control can be connected either through relays or analog output signals. Two independent controllers can operate simultaneously.
- Dosing of disinfectant can be interrupted automatically with an external signal, e.g. during sample flow interruption or filter backwashing.
- Two (optionally three) selectable measurement values are available as analog output signals.
- Alarm display and activation of alarm relay when user defined, critical limits for a measurement value are reached.
- Continuous, automatic monitoring of main instrument functions (dirty photometer, sample flow, reagents).
- Large back-lit LCD display showing all measured values and status information simultaneously.
- Factory tested, ready for installation and operation.



Options:

- Communication interface
- pH option containing pH sensor, temperature sensor, cables and electronics board.

Accessory:

- Chemical cleaning module. For details please see separate data sheet no. DenA82312000.

Order Nr.	Monitor AMI Codes-II CC AC	A–25.441.700.0
	Monitor AMI Codes-II CC DC	**A–25.442.700.0**
Option:	[ ] 3rd current signal output (0/4 – 20mA)	A-81.420.050
	[ ] Profibus DP & Modbus RTU interface (RS-485)	A-81.420.020
	[ ] USB interface	A-81.420.042
Option:	[ ] pH and temperature measurement	A-87.127.020

SWAN Analytische Instrumente AG
CH-8340 Hinwil/Switzerland
Tel. +41 44 943 63 00
swan@swan.ch · www.swan.ch

Monitor AMI Codes-II CC

Data sheet no. DenA2544X7000

Disinfectant measurement

Free chlorine, monochloramine, total residual chlorine

Measuring range	Accuracy
0.00 - 1.00 ppm	± 0.01 ppm
1.00 - 3.00 ppm	± 0.06 ppm
3.00 - 5.00 ppm	± 0.2 ppm

Combined chlorine: calculated by the difference of total residual chlorine and free chlorine.

Measurement time:	2 min.
Cycle time free chlorine:	Off, 1 - 12 min.
Cycle time total chlorine:	Off, 10 - 60 min.

pH measurement (option)

Measuring range:	pH 2 - 12
Resolution:	0.01 pH

Temperature measurement (Option)
with Nt5k sensor

Measuring range :	-30 to +100 °C
Resolution :	0.1 °C

Transmitter Specifications and Functionality

Electronics case:	Aluminum
Protection degree:	IP 66 / NEMA 4X
Display:	backlit LCD, 75 x 45 mm
Electrical connectors:	screw clamps
Ambient temperature:	-10 to +50 °C
Limit range of operation:	-25 to +65 °C
Storage and transport:	-30 to +85 °C
Humidity:	10 to 90 % relative, non condensing

Power supply

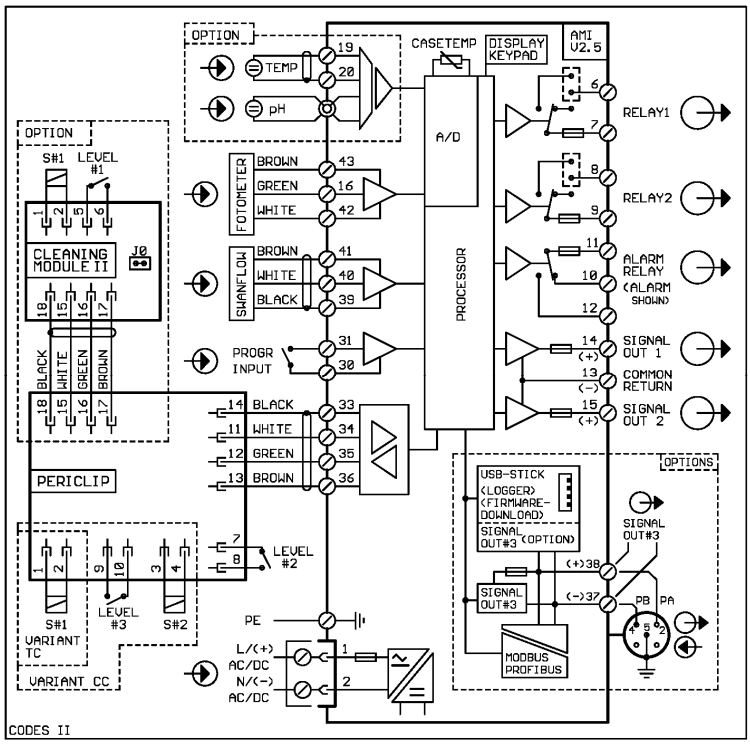
Voltage:	
AC version:	100 - 240 VAC (± 10 %), 50/60 Hz (± 5 %)
DC version	10-36 VDC
Power consumption:	max. 35 VA

Operation
Easy operation based on separate menus for “Messages”, “Diagnostics”, “Maintenance”, “Operation” and “Installation”.
User menus in English, German, French and Spanish
Separate, menu specific password protection.
Display of process value, alarm status and time during operation.
Storage of event log, and alarm log and calibration history.
Storage of the last 1’500 data records in logger with selectable time interval.

Safety features
No data loss after power failure, all data is saved in non-volatile memory. Overvoltage protection of in- and outputs. Galvanic separation of measuring inputs and signal outputs.

Transmitter temperature monitoring
With programmable high/low alarm limits.

Electrical Connection Scheme



Real-time clock with calendar
For action time stamp and preprogrammed actions.

1 Alarm relay
One potential free contact for summary alarm indication for programmable alarm values and instrument faults.

Maximum load:	1A / 250 VAC

1 Input
One input for potential-free contact. Programmable hold or remote off function.

2 Relay outputs
Two potential-free contacts programmable as limit switches for measuring values, controllers or timer with automatic hold function.

Rated load:	1A / 250 VAC

2 Signal outputs (3rd optional)
Two programmable signal outputs for measured values (freely scaleable, linear or bilinear) or as continuous control outputs (control parameters programmable) as current source. 3rd signal output selectable as current source or current sink.

Current loop:	0/4 - 20 mA
Maximum burden:	510 Ω

Control functions
Relays or current outputs programmable for 1 or 2 pulse dosing pumps, solenoid valves or for one motor valve.
Programmable P, PI, PID or PD control parameters.

1 Communication interface (option)
- RS485 interface (galvanically separated) with Fieldbus protocol Modbus RTU or Profibus DP
- 3rd Signal output
- USB interface

Monitor Data

Sample conditions

Water consumption:	min. 10 l/h
Water inlet pressure	0.15 to 2 bar
Sample temperature:	5 to 50 °C

Flow cell and connections
Made of acrylic glass with water inlet filter and needle valve.
Openings for pH and temperature sensors.

Inlet tubing:	6 x 8 mm
Outlet pressure:	atmospheric drain
Outlet tubing:	15 x 20 mm (1/2")

Panel

Panel dimensions:	400 x 850 x 200 mm
Panel material:	PVC
Weight:	12.0 kg

SWAN Analytische Instrumente AG
CH-8340 Hinwil/Switzerland
Tel. +41 44 943 63 00
swan@swan.ch · www.swan.ch

Monitor AMI ISE Universal

Data sheet No. DenA2720X010

Monitor for continuous measurement of Ammonium, Nitrate or Fluoride in potable water.

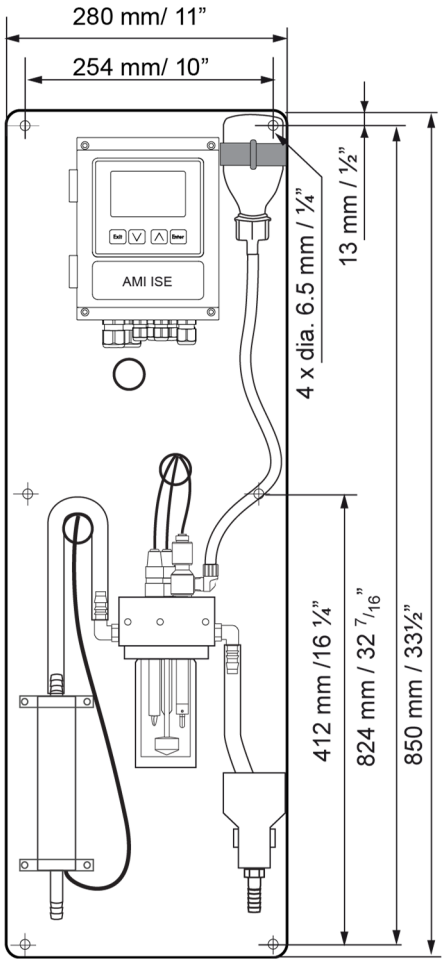
Monitor AMI ISE Universal

Complete system mounted on PVC panel:
- **Transmitter AMI ISE Universal** in a rugged aluminum enclosure (IP 66).
- **Flow cell M-Flow 10-3PG** including temperature sensor (NT5K).
- Factory tested, ready for installation and operation.

For use with:
- **Swansensor Ammonium, – Nitrate** or **- Fluoride**
- **Swansensor Reference FL**

Optional:
- Swansensor deltaT for flow detection

Specifications:
- Measuring ranges: 0.1 to 1'000 ppm (= mg/l).
- Simultaneous measurement of process value, sample temperature and sample flow (optional).
- Automatic temperature compensation according to Nernst.
- Big backlit LC display for the reading of measuring value, sample temperature, sample flow and operating status.
- Easy user menus with simple programming of all parameters by keypad.
- Electronic record of major process events and calibration data.
- Real-time clock for time stamp in data logs and for automated functions.
- Data logger for 1'500 data records stored at a selectable interval.
- Overvoltage protection for in- and outputs.
- Two current outputs (0/4 - 20 mA) for measured signals.
- Potential-free alarm contact as summary alarm indication for programmable alarm values and for instrument faults.
- Two potential-free contacts programmable as limit switch or PID-control.
- Input for potential-free contact to freeze the measuring value or to interrupt control in automated installations (hold function or remote-off).



Picture: Monitor AMI ISE Universal with deltaT-Flow detection, SS Ammonium, SS Temp NT5K and SS Reference FL.

Order Nr.	Monitor AMI ISE Universal AC	A–27.201.010
	Monitor AMI ISE Universal DC	**A–27.202.010**
Option:	[ ] Swansensor Ammonium	A-87.710.010
	[ ] Swansensor Nitrate	A-87.730.010
	[ ] Swansensor Fluoride	A-87.760.010
Option:	[ ] Swansensor Reference FL	A-87.860.100
Option:	[ ] 3rd current signal output (0/4 – 20mA)	A-81.420.050
	[ ] Profibus DP & Modbus RTU interface (RS-485)	A-81.420.020
	[ ] USB interface	A-81.420.042
	[ ] HART interface	A-81.420.060
Option:	[ ] Swansensor deltaT Flow	A-87.933.010

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Monitor AMI ISE Universal

Data sheet No. DenA2720X010

NH4-N / NO3-N / F Measurement

Signal input galvanically separated
Input resistance: > 10^{13} Ω

Ammonium, Nitrate or Fluoride measurement with appropriate Sensor.

Measuring range:	0.1 to 1'000 ppm
Display:	Resolution
0.00 to 9.99	0.01 ppm
10.0 to 99.9	0.1 ppm
100 to 1'000	1 ppm
Reference temperature:	25 °C

Automatic temperature compensation according to Nernst.

Restriction of use: direct control of fluoride dosing is not permitted.

Temperature measurement
with Swansensor Temperature (NT5K).

Measuring range:	-10 to + 50 °C
Resolution:	0.1 °C
Accuracy:	± 0.2 °C

Transmitter Specifications and Functionality

Electronics case:	Cast aluminum
Protection degree:	IP 66 / NEMA 4X
Display:	backlit LCD, 75 x 45 mm
Electrical connectors:	screw clamps
Dimensions:	180 x 140 x 70 mm
Weight:	1.5 kg
Ambient temperature:	-10 to +50 °C

Humidity: 10 - 90% rel., non condensing

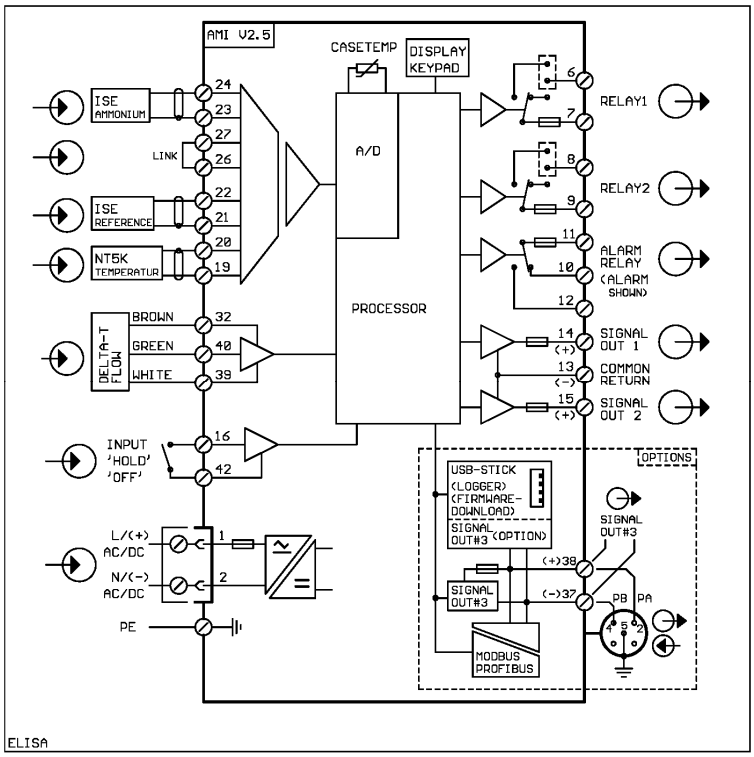
Power supply
Voltage:

AC version:	100 - 240 VAC (± 10 %), 50/60 Hz (± 5 %)
DC version:	10 - 36 VDC
Power consumption:	max. 35 VA

Operation
Easy operation based on separate menus for "Messages", "Diagnostics", "Maintenance", "Operation" and "Installation".
User menus in English, German, French and Spanish.
Separate menu specific password protection.
Display of process value, sample flow, alarm status and time during operation.
Storage of event log, alarm log and calibration history.
Storage of the last 1'500 data records in logger with selectable time interval.

Safety features
No data loss after power failure, all data is saved in non-volatile memory.
Overvoltage protection of in- and outputs.
Galvanic separation of measuring inputs and signal outputs.

Electrical Connection Scheme



Transmitter temperature monitoring
with programmable high/low alarm limits.

1 Alarm relay
One potential free contact for summary alarm indication for programmable alarm values and instrument faults.
Maximum load: 1A / 250 VAC

1 Input
One input for potential-free contact. Programmable hold or remote off function.

2 Relay outputs
Two potential-free contacts programmable as limit switches for measuring values, controllers or timer for system cleaning with automatic hold function.
Rated load: 1A / 250 VAC

2 Signal outputs (3rd as option)
Two programmable signal outputs for measured values (freely scaleable, linear or bilinear) or as continuous control output (control parameters programmable) as current source. 3rd signal output selectable as current source or current sink.

Current loop:	0/4 - 20 mA
Maximum burden:	510 Ω

Control functions
Relays or current outputs programmable for 1 or 2 pulse dosing pumps, solenoid valves or for one motor valve.
Programmable P, PI, PID or PD control parameters.

1 Communication interface (option)
- RS485 interface (galvanically separated) with Fieldbus protocol Modbus RTU or Profibus DP
- 3rd Signal output
- USB interface
- HART interface

Monitor Data

Sample conditions

Flow rate:	4 to 15 L/h
Temperature:	up to 35 °C
Inlet pressure:	up to 1 bar
Outlet pressure:	pressure free

Flow cell and connections
Flow cell made of PVC and acrylic glass.

Sample inlet:	Hose nozzle ¼"-10 elbow for Ø 10 mm tube
Sample outlet:	G ½" adapter for flexible tube Ø 20 x 15 mm

Panel

Dimensions:	280 x 850 x 150 mm
Material:	white PVC
Total weight:	6.0 kg

Guardian

Safety Stations with Eye/Face Wash

☐ G1950P Safety Station with Eye/Face Wash, Plastic Bowl

Application: Combination eye/face wash and shower safety station. Eye/face wash features a plastic bowl with two large FS-Plus™ spray-type outlet heads that deliver a flood of water for rinsing eyes and face.

Shower Head: 10" diameter orange ABS plastic with 20 GPM flow control.

Shower Valve: 1" IPS chrome plated brass stay-open ball valve. Valve is US-made with chrome plated brass ball and PTFE seals. Furnished with stainless steel actuating arm and 29" stainless steel pull rod.

Spray Head Assembly: Two FS-Plus™ spray heads. Each head has a "flip top" dust cover, internal flow control and filter to remove impurities from water flow.

Eye/Face Wash Bowl: 11-3/4" diameter orange ABS plastic.

Eye/Face Wash Valve: 1/2" IPS chrome plated brass stay-open ball valve. Valve is US-made with chrome plated brass ball and PTFE seals.

Pipe and Fittings: Schedule 40 galvanized steel. Furnished with orange polyethylene pipe covers for high visibility and corrosion resistance.

Supply: 1-1/4" NPT female top or side inlet.

Waste: 1-1/4" NPT female outlet. Outlet can be positioned at either 9-1/4" or 19-5/8" above finished floor by reversing lower pipe nipples.

Sign: ANSI-compliant identification sign.

Quality Assurance: Valve and spray head assemblies are factory assembled and water tested prior to shipment.

Available Options

- ☐ **G6040** Thermostatic mixing valve precisely blends hot and cold water to deliver tepid water as required by ANSI Z358.1-2014. Refer to "Thermostatic Mixing Valves" section for complete technical and product selection information.
- ☐ **GC** Powder coated finish on galvanized pipe and fittings. Available colors include orange, yellow, red and green.
- ☐ **GRN** Green ABS plastic shower head and bowl.
- ☐ **YEL** Yellow ABS plastic shower head and bowl.
- ☐ **SSH** Stainless steel shower head.
- ☐ **AP275-200** Electric flashing light and alarm horn unit for mounting on wall or vertical pipe. Light illuminates and horn sounds when eye/face wash or shower is activated. Furnished complete with flow switch and mounting hardware.
- ☐ **AP250-015** Modesty curtain for mounting on safety station.

Guardian Equipment
1140 N North Branch St
Chicago, IL 60642

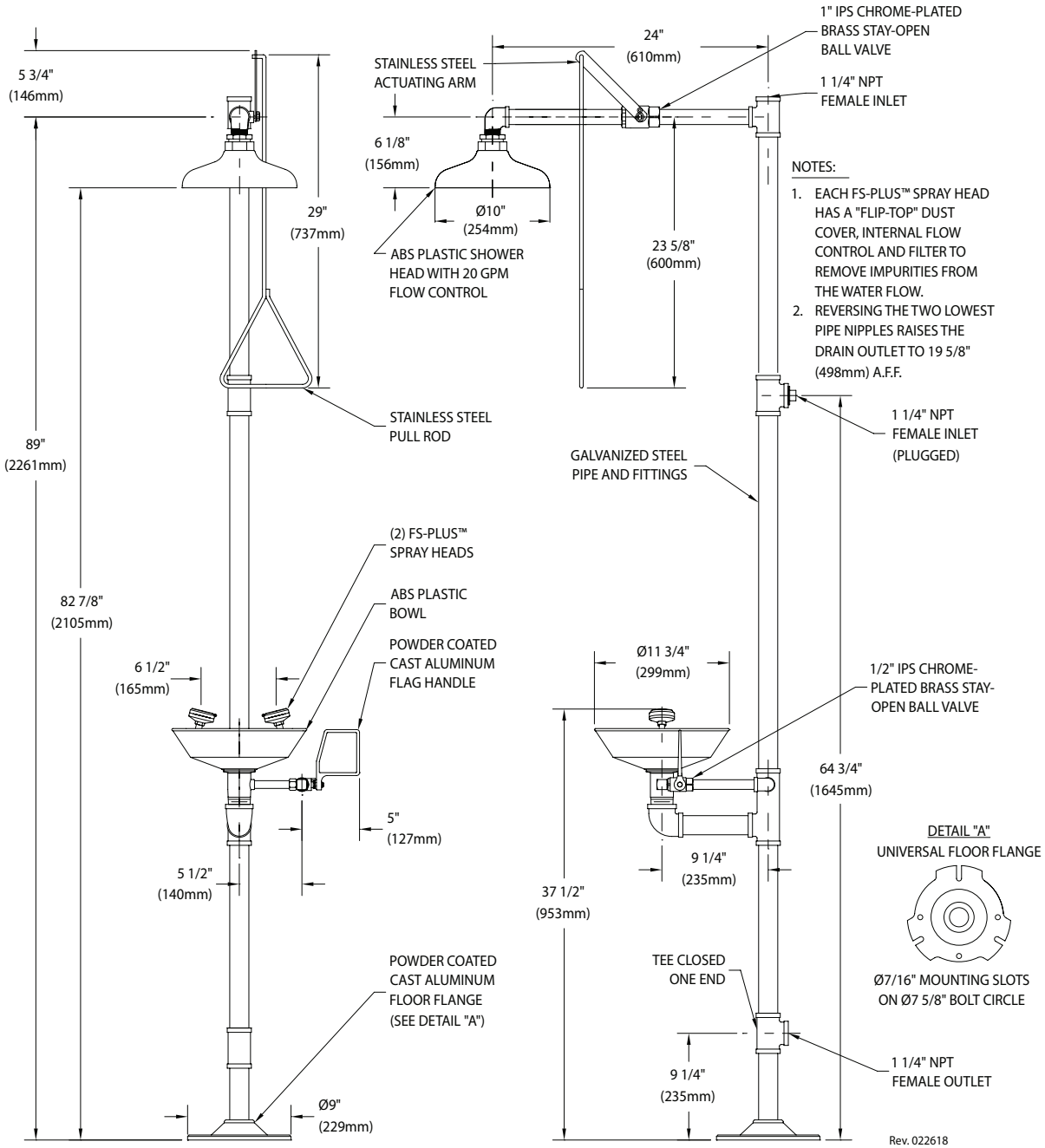
312 447 8100 TELEPHONE
312 447 8101 FACSIMILE
gesafety.com

Listed 8116. Units have been tested to and comply with ANSI Z358.1-2014 and the Uniform Plumbing Code.

Guardian

Safety Stations with Eye/Face Wash

☐ G1950P Safety Station with Eye/Face Wash, Plastic Bowl



THIS SPACE FOR ARCHITECT/ENGINEER APPROVAL

Sign Included

Due to continuing product improvement, the information contained in this document is subject to change without notice. All dimensions are ± 1/4" (6mm). rev. 040218

Guardian Equipment
1140 N North Branch St
Chicago, IL 60642

312 447 8100 TELEPHONE
312 447 8101 FACSIMILE
gesafety.com

Listed 8116. Units have been tested to and comply with ANSI Z358.1-2014 and the Uniform Plumbing Code.

Pump Performance Datasheet

Company Name	
Company contact number	
Quote Number	1526289
Project name	Default

Model/Order No.	1VR-11-00stg-1.5HP Vertical Multi-Stage
Stages	11
Quantity of pumps in parallel	1
Based on curve number	1VR-11
Saved Date	06 Sep 2023 9:27 AM

Operating Conditions

Flow, rated	: 6.00 USgpm
Head, rated (requested)	: 125.0 psi
Head, rated (actual)	: 138.5 psi
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed criteria	: Synchronous
Speed	: 3450 rpm
Impeller dia.	: 1VR-11
Impeller diameter, maximum	: 1VR-11
Impeller diameter, minimum	: 1VR-11
Efficiency	: 39.36 %
NPSH required / margin required	: 6.98 / 0.00 ft
Ns (imp. eye flow) / Nss (imp. eye flow)	: 1,106 / 2,452 US Units
MCSF	: 4.40 USgpm
Head max.	: 159.2 psi
Head rise to shutoff	: 14.96 %
Flow, best eff. point	: 10.72 USgpm
Flow ratio, rated / BEP	: 55.95 %
Diameter ratio (rated / max)	: 100.00 %
Head ratio (rated dia / max dia)	: 100.00 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 0.96 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature	: 68.00 deg F
Fluid density	: 1.000 / 1.000 SG
Viscosity	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

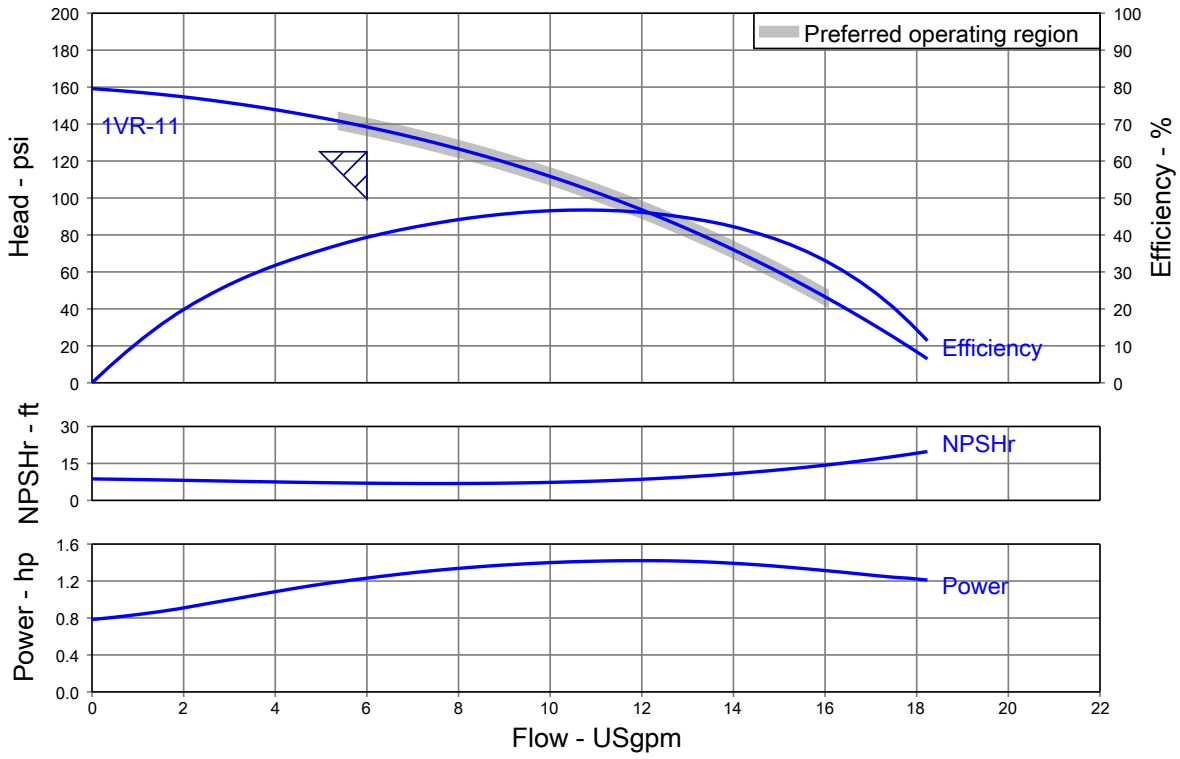
Material selected	: 316SS / 316SS

Pressure Data

Shut off pressure	: 159.2 psi.g
Maximum allowable working pressure	: N/A
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: N/A

Driver & Power Data (@Max density)

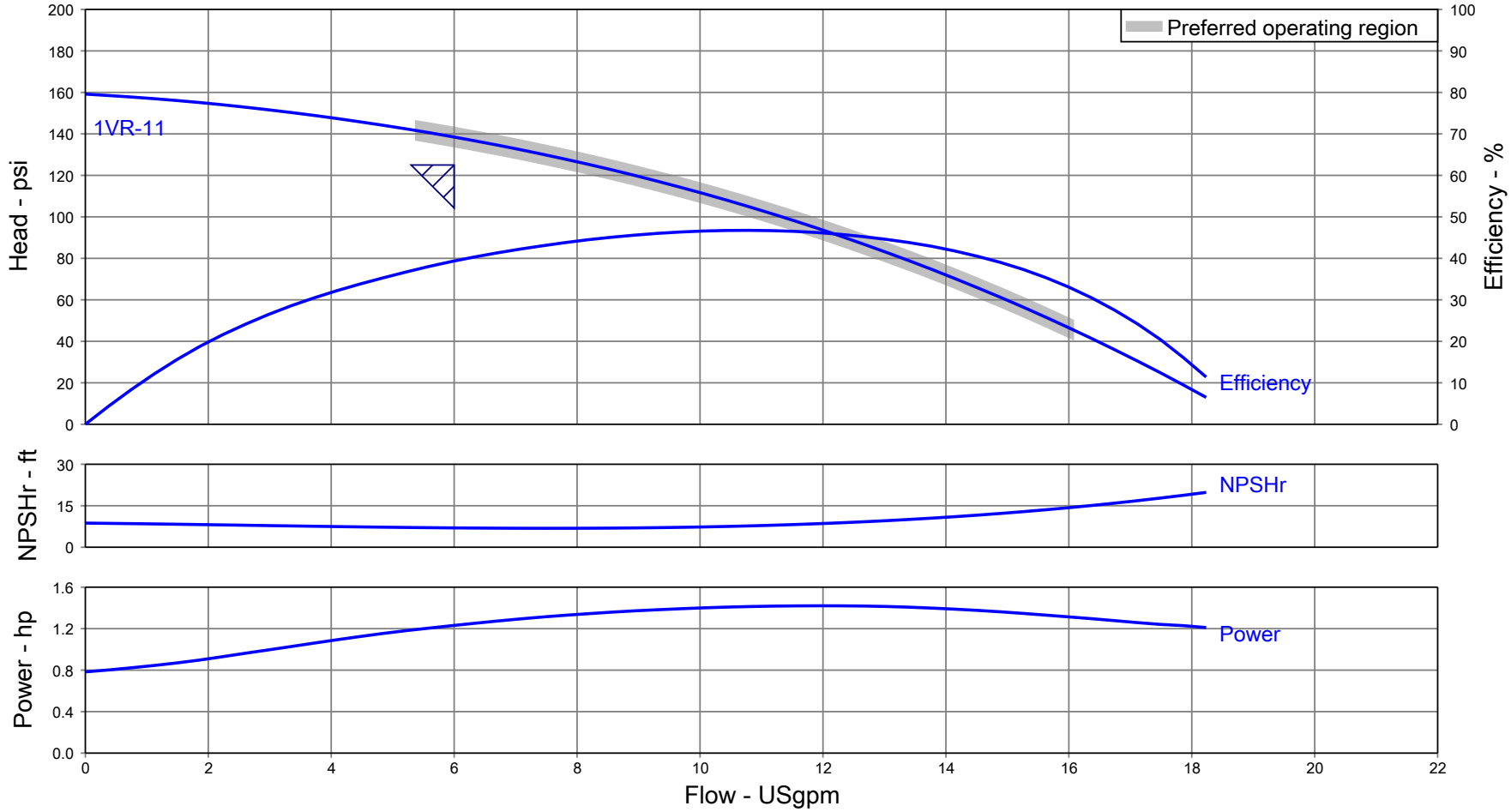
Driver sizing specification	: Rated power
Margin over specification	: 0.00 %
Service factor	: 1.15 (used)
Power, hydraulic	: 0.48 hp
Power, rated	: 1.23 hp
Power, maximum	: 1.42 hp
Motor rating	: 1.50 hp / 1.12 kW



Pump Performance Curve

Company Name	
Company contact number	

Quote Number	1526289
Quote Date	05 Nov 2021
Project name	Default



Description	: 1VR-11-00stg-1.5HP Vertical Multi-Stage
Stages	: 11
Flow, rated	: 6.00 USgpm
Head, rated	: 125.0 psi

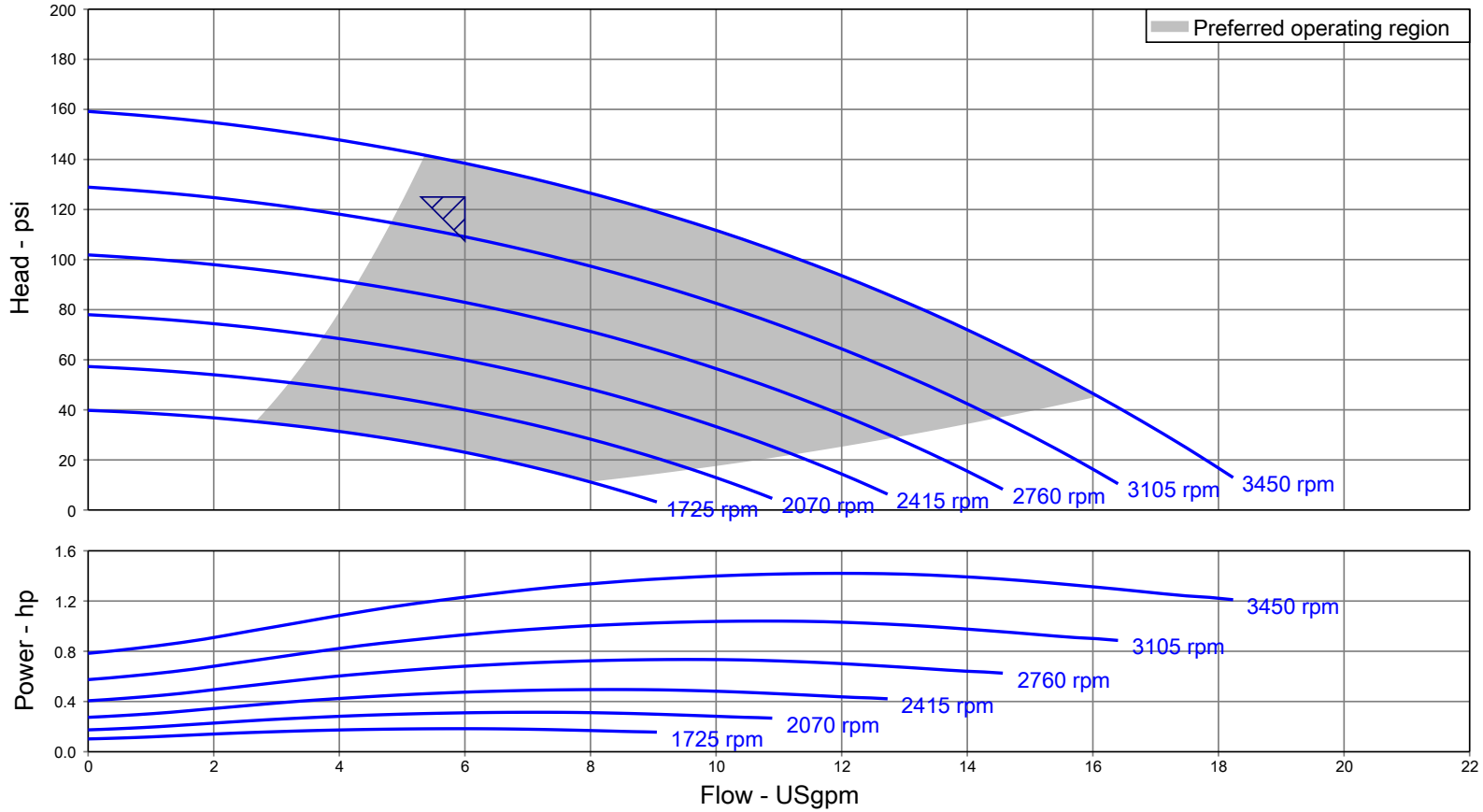
Speed	: 3450 rpm
Based on curve number	: 1VR-11
Efficiency	: 39.36 %
Power, rated	: 1.23 hp

NPSH required	: 6.98 ft
Fluid density	: 1.000 / 1.000 SG
Viscosity	: 1.00 cP
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 0.96 / 1.00
Saved Date	: 06 Sep 2023 9:27 AM

Multi-Speed Performance Curve

Company Name	
Company contact number	

Quote Number	1526289
Quote Date	05 Nov 2021
Project name	Default



Description	: 1VR-11-00stg-1.5HP Vertical Multi-Stage
Stages	: 11
Flow, rated	: 6.00 USgpm
Head, rated	: 125.0 psi

Speed	: 3450 rpm
Based on curve number	: 1VR-11
Efficiency	: 39.36 %
Power, rated	: 1.23 hp
Impeller dia.	: 0.02 in

NPSH required	: 6.98 ft
Fluid density	: 1.000 / 1.000 SG
Viscosity	: 1.00 cP
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 0.96 / 1.00
Saved Date	: 06 Sep 2023 9:27 AM

Pump Performance - Additional Data

Company Name	
Company contact number	
Quote Number	1526289
Project name	Default

Model/Order No.	1VR-11-00stg-1.5HP Vertical Multi-Stage
Stages	11
Quantity of pumps in parallel	1
Based on curve number	1VR-11
Saved Date	06 Sep 2023 9:27 AM

Performance Data	
Head, maximum diameter, rated flow	: 138.5 psi
Head, minimum diameter, rated flow	: 138.5 psi
Head max.	: 159.2 psi
Efficiency adjustment factor, total	: 1.00
Power adjustment, total	: 0.00 hp
Head adjustment factor, total	: 1.00
Flow adjustment factor, total	: 1.00
Flow adjustment factor, efficiency only (shift BEP)	: 1.00
Flow adjustment factor, end-of-curve only, total	: 1.00
MCSF adjustment factor	: 1.00
NPSHR adjustment factor, total	: 1.00
User applied performance adjustment comments	:
NPSH margin dictated by pump supplier	: 0.00 ft
NPSH margin dictated by user	: 0.00 ft
NPSH margin used (added to 'required' values)	: 0.00 ft

Stage, Speed and Solids Limits	
Stages, maximum	: 11
Stages, minimum	: 11
Pump speed limit, maximum	: 3600 rpm
Pump speed limit, minimum	: 1800 rpm
Curve speed limit, maximum	: 3600 rpm
Curve speed limit, minimum	: 1200 rpm
Variable speed limit, maximum	: -
Variable speed limit, minimum	: 800 rpm
Solids size limit	: 0.00 in
Typical Driver Data	
Driver speed, full load	: 3450 rpm
Driver speed, rated load	: 3477 rpm
Driver efficiency, 100% load	: 82.50 %
Driver efficiency, 75% load	: 82.00 %
Driver efficiency, 50% load	: 78.00 %

Mechanical Limits	
Torque, rated power, rated speed	: 0.04 hp/100 rpm
Torque, maximum power, rated speed	: 0.04 hp/100 rpm
Torque, driver power, full load speed	: 0.04 hp/100 rpm
Torque, driver power, rated speed	: 0.04 hp/100 rpm
Torque, pump shaft limit	: -
Radial load, worst case	: -
Radial load limit	: -
Impeller peripheral speed, rated	: -
Impeller peripheral speed limit	: -

Various Performance Data	**Flow (USgpm)**	**Head (psi)**	**Efficiency (%)**	**NPSHr (ft)**	**Power (hp)**
Shutoff, rated	0.00	159.2	-	-	0.78
Shutoff, maximum	0.00	159.2	-	-	0.78
MCSF	4.40	146.1	33.54	7.37	1.12
Rated flow, minimum	6.00	138.5	39.36	-	1.23
Rated flow, maximum	6.00	138.5	39.36	-	1.23
BEP flow, rated	10.72	105.5	46.75	7.66	1.41
120% rated flow, rated	7.20	131.6	42.51	6.85	1.30
End of curve, rated	18.23	12.96	11.39	19.82	1.21
End of curve, minimum	18.23	12.96	11.39	19.82	1.21
End of curve, maximum	18.23	12.96	11.39	19.82	1.21
Maximum value, rated	-	159.2	46.75	-	1.42
Maximum value, maximum	-	-	46.75	-	1.42

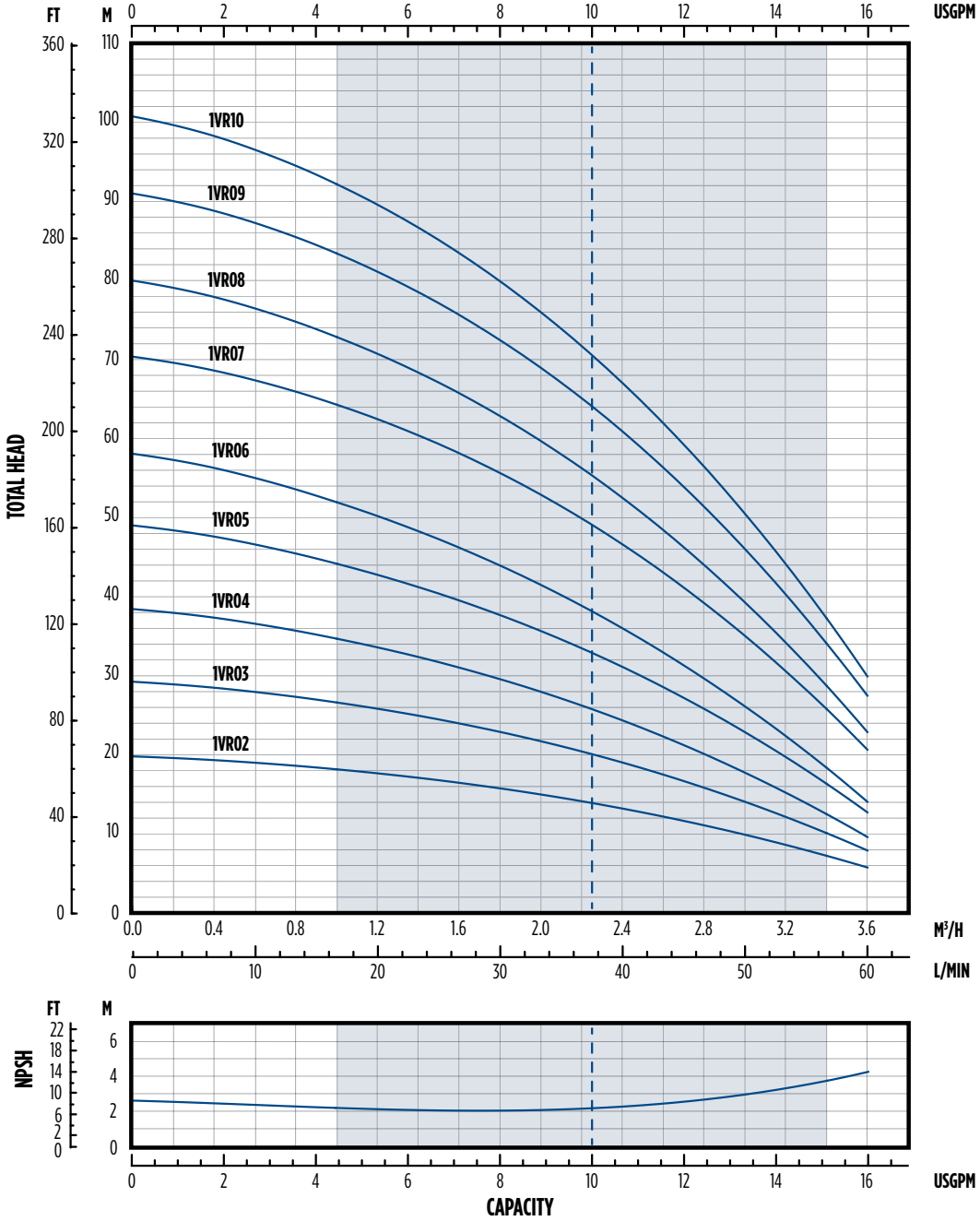
System differential pressure	**@ Density, rated**	**@ Density, max**
Differential pressure, rated flow, rated (psi)	138.5	138.5
Differential pressure, shutoff, rated (psi)	159.2	159.2
Differential pressure, shutoff, maximum (psi)	159.2	159.2

Discharge pressure	**@ Suction pressure, rated**	**@ Suction pressure, max**	**@ Suction pressure, rated**	**@ Suction pressure, max**
Discharge pressure, rated flow, rated (psi.g)	138.5	138.5	138.5	138.5
Discharge pressure, shutoff, rated (psi.g)	159.2	159.2	159.2	159.2
Discharge pressure, shutoff, maximum (psi.g)	159.2	159.2	159.2	159.2

Ratios			
Maximum flow / rated flow, rated	: 249.50 %	Head rated diameter / head minimum diameter, rated flow	: 100.00 %

VR SERIES - 1 VR

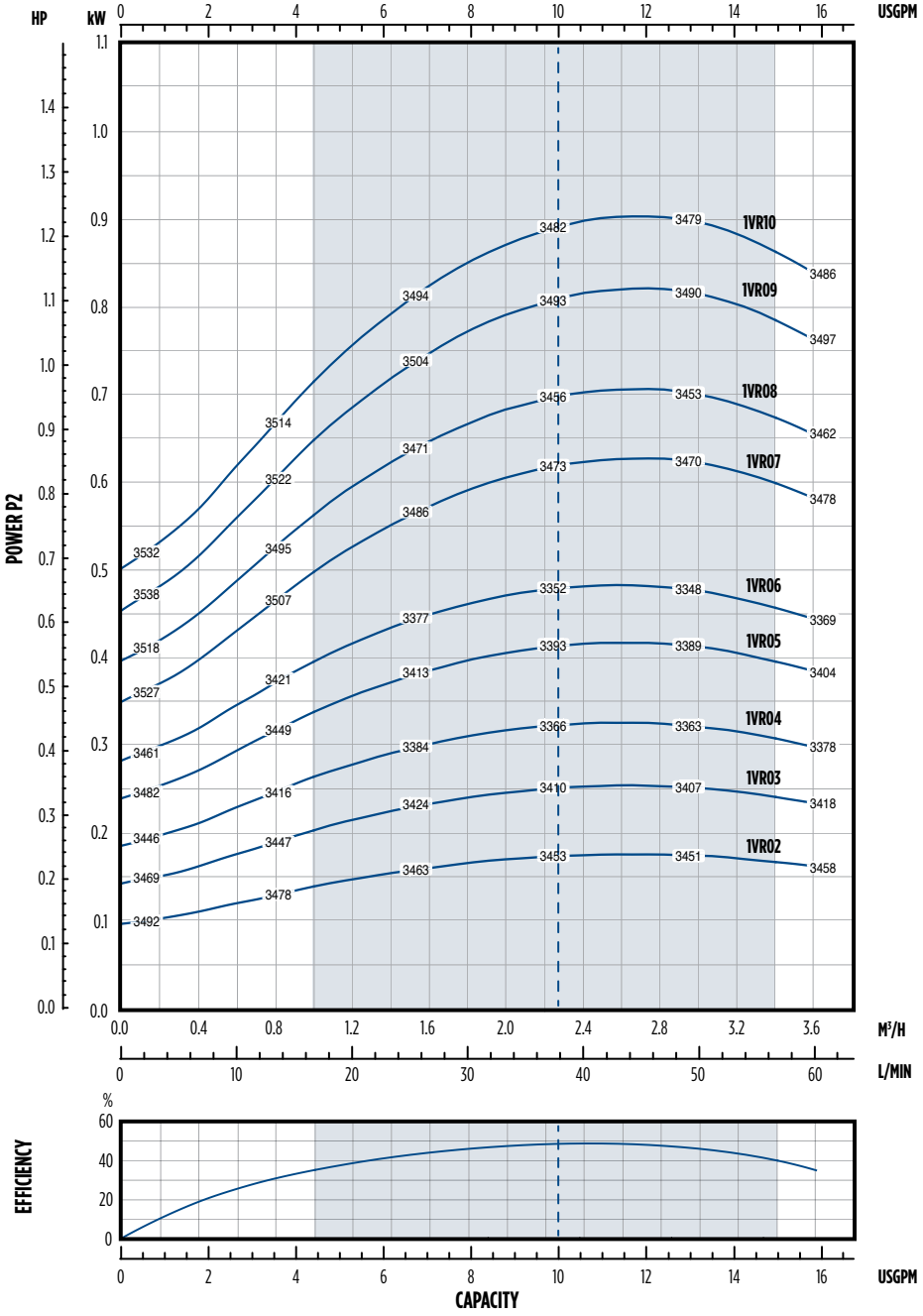
PERFORMANCE: 2-POLE



Note: Specifications subject to change without prior notice. Hydraulic characteristics are according to ISO standard 9906, Annex A.

VR SERIES - 1 VR

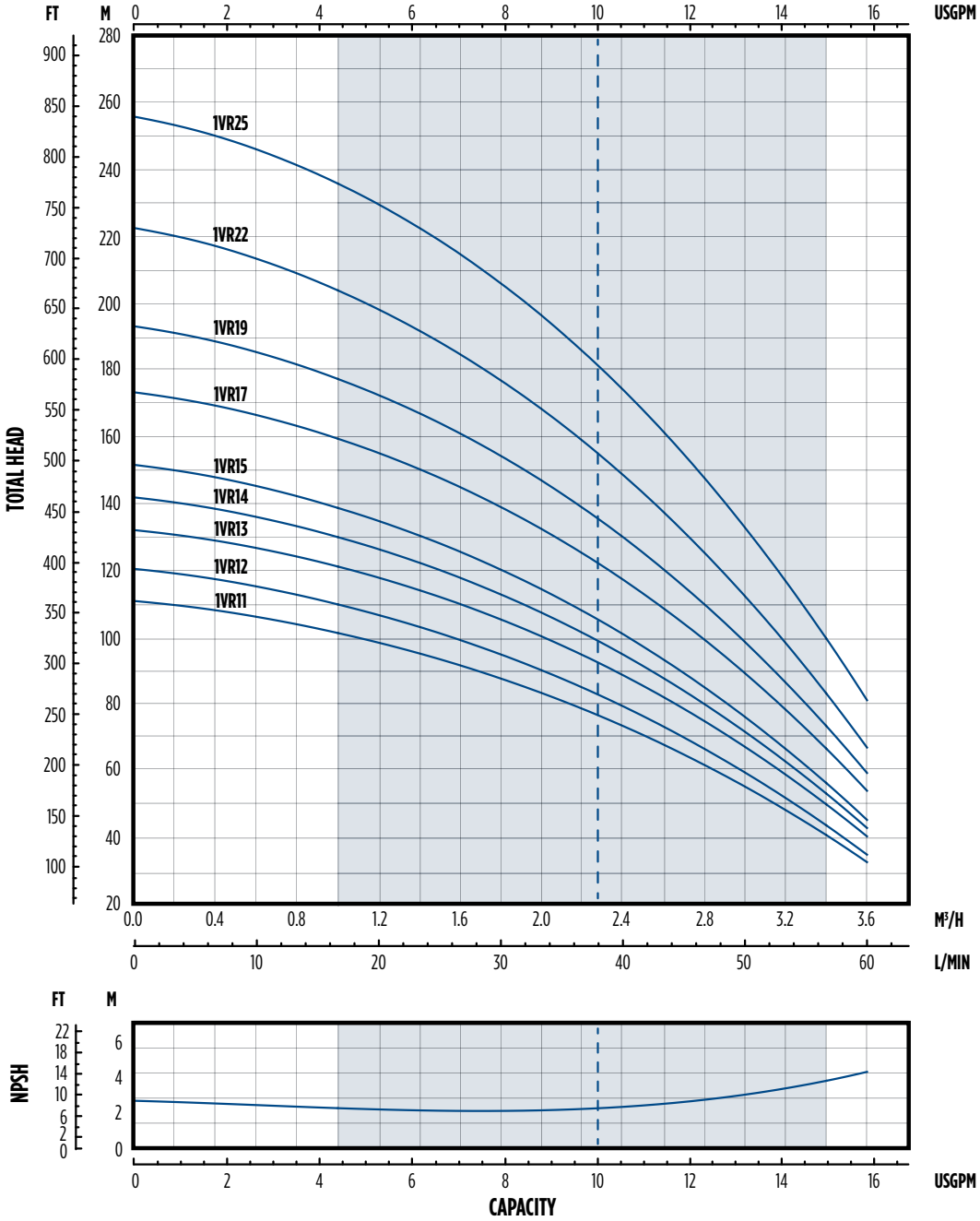
POWER CURVE: 2-POLE



Note: Specifications subject to change without prior notice.

VR SERIES - 1 VR

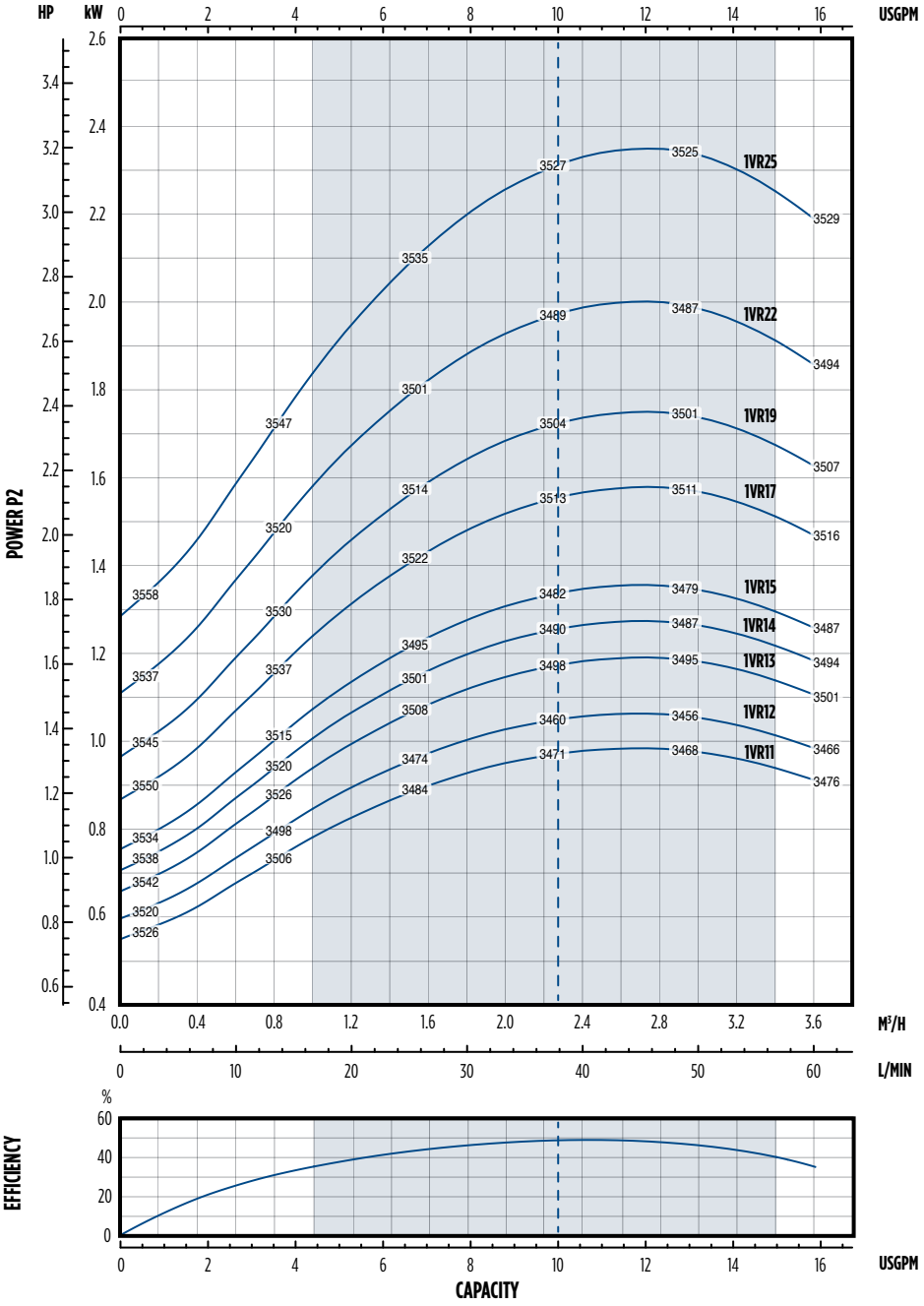
PERFORMANCE: 2-POLE



Note: Specifications subject to change without prior notice. Hydraulic characteristics are according to ISO standard 9906, Annex A.

VR SERIES - 1 VR

POWER CURVE: 2-POLE

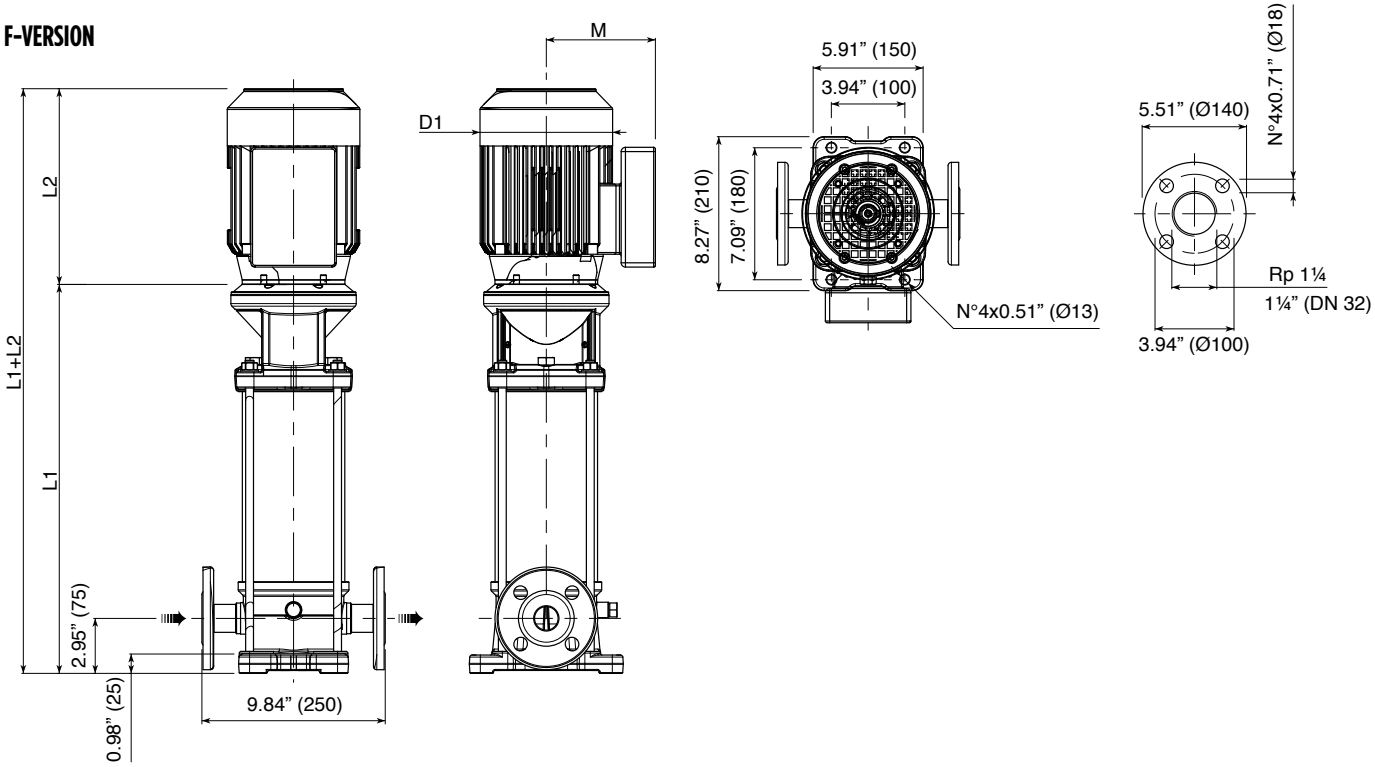


Note: Specifications subject to change without prior notice.

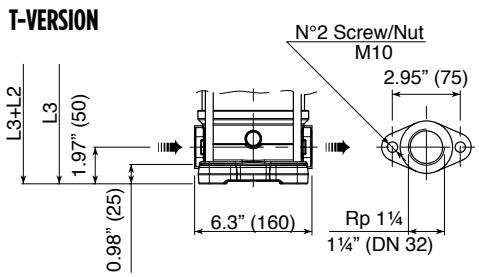
VR SERIES - 1 VR

DIMENSIONS: 2-POLE

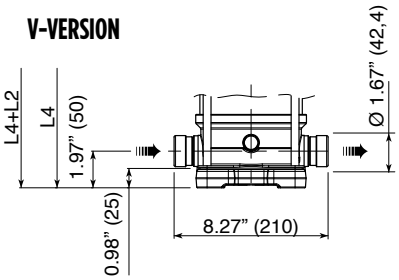
F-VERSION



T-VERSION



V-VERSION



F-Version: Round flanges on body type PN25; pump is supplied without counter-flanges (optional accessories, including bolts and joints).
T-Version: Oval flanges on body type PN16; pump is supplied without threaded oval counter-flanges (optional accessories, including bolts and joints).
V-Version: Grooved or rapid connection fitted pump casing is supplied without the collars (optional accessories).

VR SERIES - 1 VR

DIMENSIONS: 2-POLE

Model	No Stages	2-Pole Motor Rating			PEA Only Height (in)		
		Power		NEMA Frame Size	L1 "F" Fitted	L3 "T" Fitted	L4 "V" Fitted
		HP	kW				
1VR0200	2	0.50	0.37	56C	12.30	11.32	11.32
1VR0300	3	0.50	0.37	56C	13.19	12.20	12.20
1VR0400	4	0.50	0.37	56C	14.07	13.09	13.09
1VR0500	5	0.75	0.55	56C	14.96	13.98	13.98
1VR0600	6	0.75	0.55	56C	15.85	14.86	14.86
1VR0700	7	0.75	0.55	56C	16.73	15.75	15.75
1VR0800	8	1.00	0.75	56C	17.62	16.63	16.63
1VR0900	9	1.00	0.75	56C	18.50	17.52	17.52
1VR1000	10	1.50	1.10	56C	19.39	18.41	18.41
1VR1100	11	1.50	1.10	56C	20.28	19.29	19.29
1VR1200	12	1.50	1.10	56C	21.16	20.18	20.18
1VR1300	13	1.50	1.10	56C	22.44	21.46	21.46
1VR1400	14	2.00	1.50	56C	23.33	22.34	22.34
1VR1500	15	2.00	1.50	56C	24.21	23.23	23.23
1VR1700	17	2.00	1.50	56C	25.98	N.A.	25.00
1VR1900	19	2.00	1.50	56C	27.76	N.A.	26.77
1VR2200	22	3.00	2.20	56C	30.41	N.A.	29.43
1VR2500	25	3.00	2.20	56C	33.46	N.A.	32.48

Model	No Stages	3600 RPM, 2-Pole Motor Dimensions (in)											
		L2 Height				D1 Diameter				M (max)			
		1Ø ODP	3Ø ODP	1Ø TEFC	3Ø TEFC	1Ø ODP	3Ø ODP	1Ø TEFC	3Ø TEFC	1Ø ODP	3Ø ODP	1Ø TEFC	3Ø TEFC
1VR0200	2	9.79	9.16	9.29	9.29	6.19	6.19	6.19	6.19	5.06	5.06	5.18	5.19
1VR0300	3	9.79	9.16	9.29	9.29	6.19	6.19	6.19	6.19	5.06	5.06	5.18	5.19
1VR0400	4	9.79	9.16	9.29	9.29	6.19	6.19	6.19	6.19	5.06	5.06	5.18	5.19
1VR0500	5	11.98	9.16	9.91	9.29	6.19	6.19	6.19	6.19	5.06	5.06	5.19	5.19
1VR0600	6	11.98	9.16	9.91	9.29	6.19	6.19	6.19	6.19	5.06	5.06	5.19	5.19
1VR0700	7	11.98	9.16	9.91	9.29	6.19	6.19	6.19	6.19	5.06	5.06	5.19	5.19
1VR0800	8	10.00	9.78	10.19	10.17	7.01	6.19	7.19	7.19	5.62	5.06	5.74	5.23
1VR0900	9	10.00	9.78	10.19	10.17	7.01	6.19	7.19	7.19	5.62	5.06	5.74	5.23
1VR1000	10	12.04	10.17	11.19	10.17	7.01	7.19	7.19	7.19	5.62	5.62	5.72	5.23
1VR1100	11	12.04	10.17	11.19	10.17	7.01	7.19	7.19	7.19	5.62	5.62	5.72	5.23
1VR1200	12	12.04	10.17	11.19	10.17	7.01	7.19	7.19	7.19	5.62	5.62	5.72	5.23
1VR1300	13	12.04	10.17	11.19	10.17	7.01	7.19	7.19	7.19	5.62	5.62	5.72	5.23
1VR1400	14	13.41	11.22	11.18	11.17	7.01	7.19	7.19	7.19	5.62	5.62	5.72	5.23
1VR1500	15	13.41	11.22	11.18	11.17	7.01	7.19	7.19	7.19	5.62	5.62	5.72	5.23
1VR1700	17	13.41	11.22	11.18	11.17	7.01	7.19	7.19	7.19	5.62	5.62	5.72	5.23
1VR1900	19	13.41	11.22	11.18	11.17	7.01	7.19	7.19	7.19	5.62	5.62	5.72	5.23
1VR2200	22	N.A.	11.18	12.06	12.04	N.A.	7.19	7.19	7.19	N.A.	5.62	5.79	5.74
1VR2500	25	N.A.	11.18	12.06	12.04	N.A.	7.19	7.19	7.19	N.A.	5.62	5.79	5.74

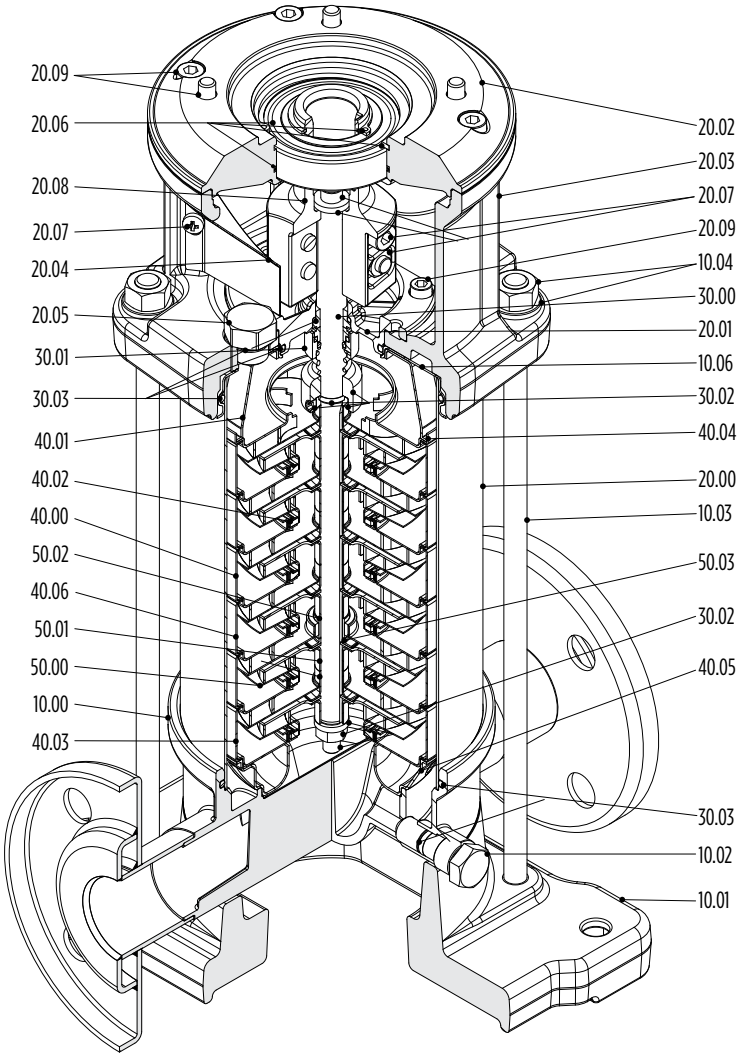
VR SERIES - MATERIALS

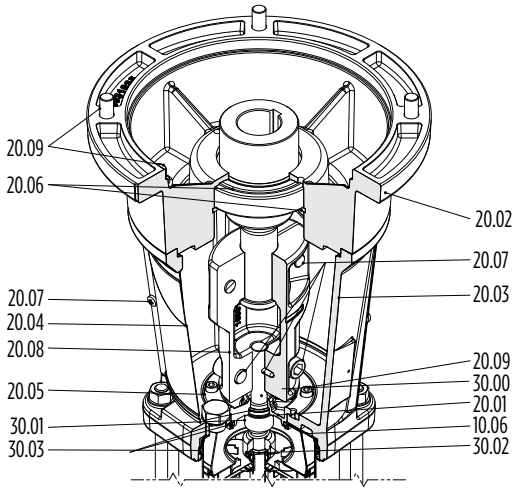
1-3-6-10 VR

Ref. No.	Part Description	Material		
		Type	N - 316SS version	
			ASTM/AISI	DIN / EN
10.00	Pump casing	Stainless Steel	CF 8M / AISI 316	1.4408
10.02	Filling and draining plug	Stainless Steel	AISI 316	1.4401
20.00	Outer Case	Stainless Steel	AISI 316	1.4401
20.01	Mechanical seal housing	Stainless Steel	AISI 316	1.4401
20.05	Filling plugs	Stainless Steel	AISI 316	1.4401
30.00	Pump shaft	Stainless Steel	AISI 316	1.4401
30.01	Kit Mechanical seal	Silicon Carbide SiC, Graphite, EPDM, Stainless Steel	-	-
30.02	Mechanical seal fastening kt	Stainless Steel	AISI 316	1.4401
30.03	Kit O-rings	EPDM	-	-
40.00	Stage housing and diffuser	Stainless Steel	AISI 316	1.4401
40.01	Stage centering outlet	Stainless Steel	AISI 316	1.4401
40.02	Floating neck ring	PPS	-	-
40.03	Initial stage housing	Stainless Steel	AISI 316	1.4401
40.04	Last stage with diffuser	Stainless Steel	AISI 316	1.4401
40.05	Stage centering inlet	Stainless Steel	AISI 316	1.4401
40.06	Stage housing and diffuser with bearing	Stainless Steel, Tungsten Carbide WC	AISI 316	1.4401
50.00	Impeller	Stainless Steel	AISI 316	1.4401
50.01	Impeller Spacer	Stainless Steel	AISI 316	1.4401
50.02	Intermediary sleeve	Tungsten Carbide WC	-	-
50.03	Intermediary sleeve spacer	Stainless Steel	AISI 316	1.4401

VR SERIES - MAIN COMPONENTS

1-3-6-10 VR





Ref. No.	Description
10.00	Pump Casing
10.01	Pump Fixing Plate
10.02	Filling and Draining Plug
10.03	Tie Bolt
10.04	Kit Nuts and Washers
10.06	Upper Flange
20.00	Outer Case
20.01	Mechanical Seal Housing
20.02	Motor Flange
20.03	Motor Bracket
20.04	Coupling Guard
20.05	Filling Plugs
20.06	Circlips and Bearings, and O-ring
20.07	Coupling Fasteners
20.08	Coupling
20.09	Kit Motor Screws

Ref. No.	Description
30.00	Pump Shaft
30.01	Kit Mechanical Seal
30.02	Mechanical Seal Fastening Kit
30.03	Kit O-rings
40.00	Stage Housing and Diffuser
40.01	Stage Centering Outlet
40.02	Floating Neck Ring
40.03	Initial Stage Housing
40.04	Last Stage with Diffuser
40.05	Stage Centering Inlet
40.06	Stage Housing and Diffuser with Bearing
50.00	Impeller
50.01	Impeller Spacer
50.02	Intermediary Sleeve
50.03	Intermediary Sleeve Spacer

PRODUCT CATALOG

FPS

VR SERIES

VERTICAL MULTI-STAGE PUMPS

franklinwater.com

Franklin Electric

VR SERIES VERTICAL MULTI-STAGE PUMPS – 60HZ

STANDARD FEATURES & BENEFITS - ALL MODELS

- All 316 SS wetted components for superior durability, efficiency, and performance over a wide variety of applications (except G version of 30-45-65-95VR with CI casing and upper flange standard)
- Rugged NEMA motor mounting with oversized thrust bearing ensures long operating life in the toughest jobs (special, heavy-duty motor bearing not required)
- Silicon carbide/graphite/EPDM/SS mechanical seal for superior sealing
- Removeable stainless steel seal plate with jack screw taps provided for ease of service
- In-line suction and discharge connections with round ANSI flanges fit widest range of applications and provide for convenient, compact installation with a small footprint
- NEMA standard motors; ODP & TEFC enclosures, 1 & 3 phase voltages available with all 3-phase motors of premium efficiency design and inverter duty rated

GENERAL PUMP SPECIFICATIONS

- Flow range: 5 to 500 GPM (20 to 2,000 L/Min)
- Head range: Up to 750 feet (230 M)
- 230 psi (16 bar) max working pressure for oval flange connection models (1-20VR)
  360 psi (25 bar) max working pressure for round flange & grooved connection equipped models
  460 psi (32 bar) max working pressure for round flange 30 & 45VR models only
- Liquid Temp: +14 ˚F (-10 ˚C) to +248 ˚F (+120 ˚C)
- Clockwise rotation (looking at the pump from the top down)
- Round ANSI flange standard; optional oval flange & grooved connections available through 20VR
- 3600 & 1800 RPM performance available
- Optional seals: Silicon carbide & Tungsten carbide
- Optional elastomer: FKM

APPLICATIONS

Water Supply and Pressure Boosting

- Pressure boosting in buildings
- Booster stations
- Pump packages

Water treatment

- Filtration systems
- Reverse osmosis systems

Light Industry

- Commercial washers
- Firefighting systems
- Machine coolant recirculation
- Car wash systems

Irrigation and Agriculture

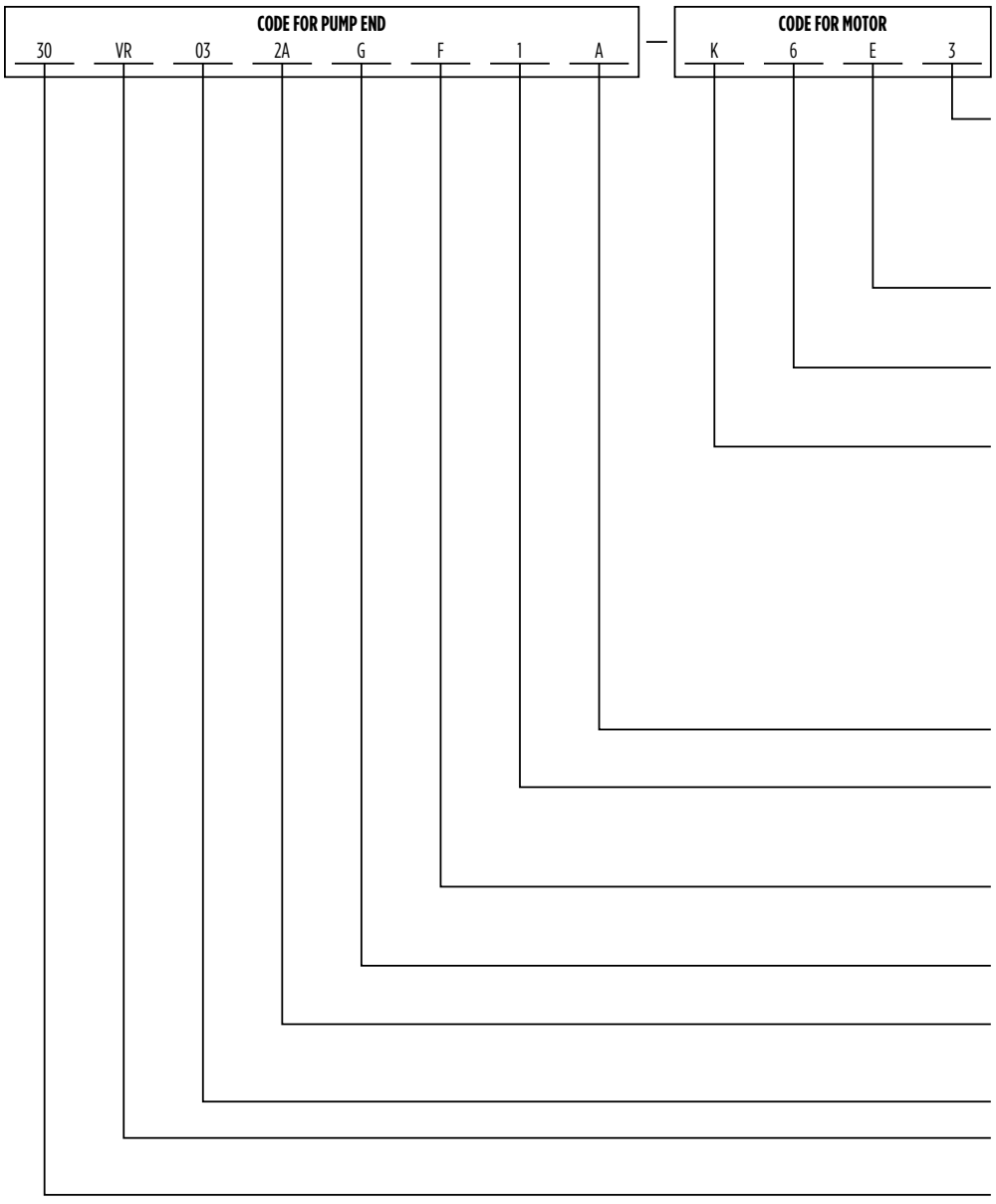
- Drip irrigation
- Sprinkler irrigation

Heating, Ventilation, and Air Conditioning (HVAC)

- Cooling towers
- Temperature control
- Refrigeration
- Heating systems
- Boiler feed
- Water recirculation

VR SERIES

MODEL NOMENCLATURE



Voltage (Phase)

1 = 115/230 (1-Phase)	2 = 230 only (1-Phase)
3 = 230/460 (3-Phase)	4 = 460 only (3-Phase)
5 = 575 only (3-Phase)	6 = 220 (1-Phase)
7 = 220 (3-Phase)	8 = 380/415 (3-Phase)
9 = 415 (3-Phase)	A = 190/380 (3-Phase)
B = 230/400 (3-Phase)	C = 400/690 (3-Phase)

Efficiency (Enclosure)

D = Premium (ODP)	E = Premium (TEFC)
X = Premium (X-Proof)	

Speed (Hz)

5 = 3000 RPM (50 Hz)	6 = 3600 RPM (60 Hz)
7 = 1500 RPM (50 Hz)	8 = 1800 RPM (60 Hz)

Frame (Kw)

A = 56C 0.5 HP (0.37 Kw)	B = 56C 0.75 HP (0.55 Kw)
C = 56C 1 HP (0.75 Kw)	D = 56C 1.5 HP (1.1 Kw)
E = 56C 2 HP (1.5 Kw)	F = 56C 3 HP (2.2 Kw)
U = 180TC 3 HP (2.2 Kw)	G = 180TC 5 HP (3.7 Kw)
V = 180TC 7.5 HP (5.5 Kw)	H = 210TC 7.5 HP (5.5 Kw)
J = 210TC 10 HP (7.5 Kw)	W = 210TC 15 HP (11 Kw)
K = 250TC 15 HP (11 Kw)	L = 250TC 20 HP (15 Kw)
X = 250TC 25 HP (18.5 Kw)	M = 280TSC 25 HP (18.5 Kw)
N = 280TSC 30 HP (22 Kw)	Z = 280TSC 40 HP (30 Kw)
P = 320TSC 40 HP (30 Kw)	R = 320TSC 50 HP (37 Kw)
S = 360TSC 60 HP (45 Kw)	T = 360TSC 75 HP (55 Kw)

Motor Type

A = NEMA	B = IEC

Seal Type

1 = Graphite/SiC EPDM	2 = SiC/SiC EPDM
3 = SiC/SiC FKM	4 = Graphite/SiC FKM
5 = WC/WC EPDM	6 = WC/WC FKM

Connection Type

F = Round Flange	T = Oval Flange
V = Grooved	

Casing/Hydraulics

G = CI/316SS	N = 316SS/316SS

Impeller Trim

0 = No Trim	1A = 1 Stage
2A = 2 Stages	

Total Number of Stages (always 2 Characters)

Series & Speed

VR = VR Series (2-Pole)	VRL = VRL Series (4-Pole)

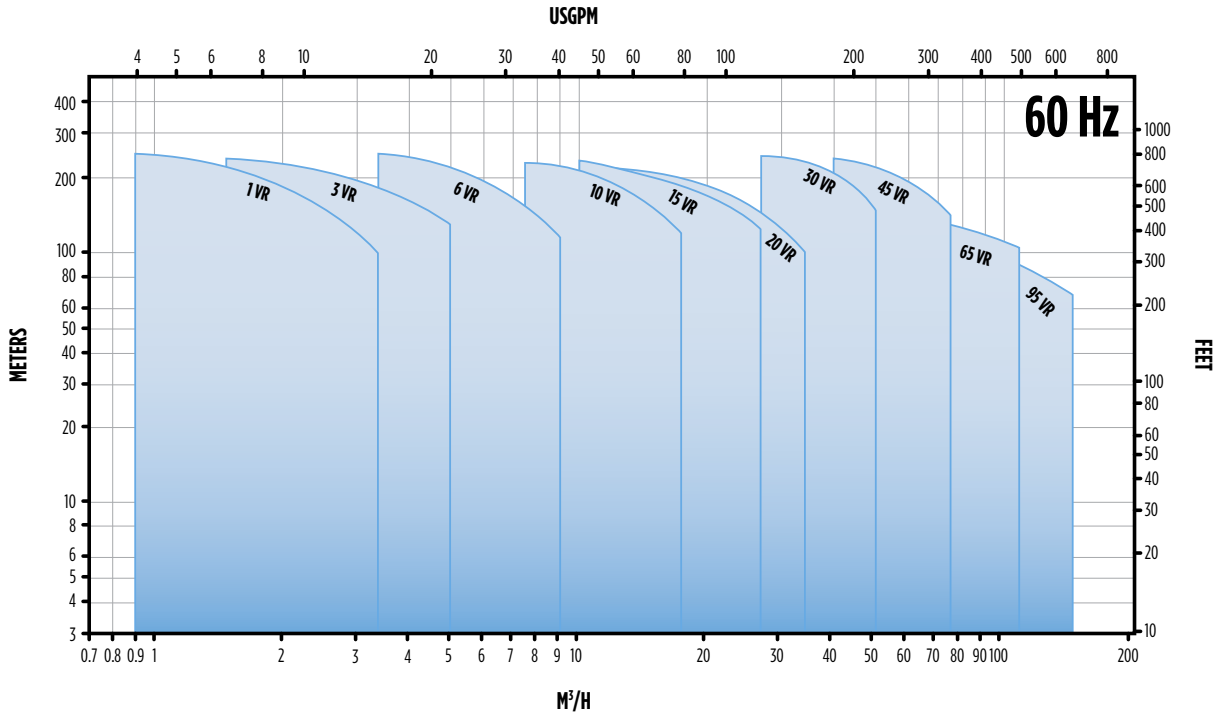
BEP Flow (60Hz-2P)

1 = 10 GPM	3 = 16 GPM
6 = 32 GPM	10 = 60 GPM
15 = 90 GPM	20 = 110 GPM
30 = 160 GPM	45 = 240 GPM
65 = 360 GPM	95 = 450 GPM

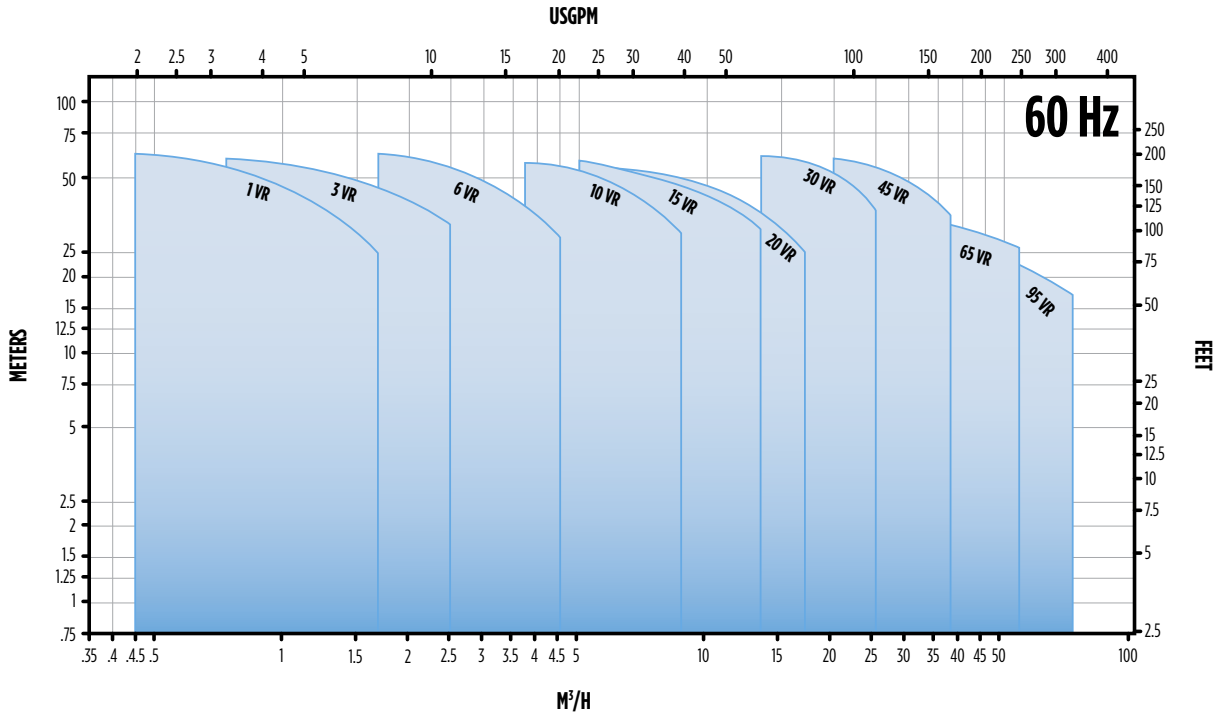
**Note: Nominal flow will be half of aboce at 4-pole (1800 RPM) operation*

VR SERIES

FAMILY CURVE - 2-POLE



FAMILY CURVE - 4-POLE



Appendix H: Coating Carboline Data Sheets

Carboxane® 2000

PRODUCT DATA SHEET

SELECTION & SPECIFICATION DATA

Generic Type	Modified Siloxane Hybrid
Description	Carboxane 2000 is an isocyanate free, ultra-durable coating that provides outstanding color and gloss retention as well as excellent corrosion protection for exterior exposures. When used over a suitable primer (as a two coat system) Carboxane 2000 provides the barrier, corrosion resistance properties, and weatherability normally achieved with a three-coat system (primer, epoxy intermediate with an acrylic-polyurethane finish) for most environments. This significantly speeds up the painting process, saves labor, and saves money without sacrificing performance. This tightly cross-linked film utilizes a UV-resistant siloxane binder resulting in a finish with excellent corrosion protection and weathering performance that far exceeds aliphatic polyurethanes.
Features	• Isocyanate free • Exceptional weatherability • Outstanding color and gloss retention • Exceeds SSPC Coating Specification No. 36 Level 3A • Excellent corrosion protection • Meets ISO 12944 C3 High and C4 Medium, one coat applied at 5 to 7 mils DFT • High build, 3 to 7 mils DFT • Saves significant time, labor, and money • Long service life • VOC compliant • Excellent durability • Good flexibility and abrasion resistance • Long pot life
Color	Refer to Carboline Color Guide
Finish	Gloss
Primer	Self-priming, can be used Direct-to-Metal in mild environments. For moderate to heavily corrosive environments, prime with Carbozinc, Carboguard, or Carbomastic Series or other primers as recommended by Carboline Technical Service.
Dry Film Thickness	3 - 7 mils (76 - 178 microns) per coat As the finish of a two coat system (over a primer) a minimum of 5 mils (125 microns) is recommended. As the finish of a three coat system (primer and intermediate coat), a minimum of 3 mils (75 microns) is recommended. See Severe Exposures below.
Solids Content	By Volume 75% +/- 2%
Surface Burning Characteristics	Flame Spread Index: 0 Smoke Developed Index: 10
Theoretical Coverage Rate	1203 ft²/gal at 1.0 mils (29.5 m²/l at 25 microns) 401 ft²/gal at 3.0 mils (9.8 m²/l at 75 microns) 172 ft²/gal at 7.0 mils (4.2 m²/l at 175 microns) Allow for loss in mixing and application.
Severe Exposures	For severe marine environments (offshore structures) a three coat system is recommended. For other severe exposures, a two coat system may be used provided the minimum film thickness of 5 mils (125 microns) is achieved.

SELECTION & SPECIFICATION DATA

VOC Values	**As Supplied** : 1.8 lbs/gal (216 g/l) mixed Thinner 10 : 13 oz/gal: 2.29 lbs/gal (275 g/l) These are nominal values and may vary with color
Dry Temp. Resistance	Continuous: 302°F (150°C) Non-Continuous: 338°F (170°C) Some discoloration and loss of gloss may be experienced at elevated temperatures.

SUBSTRATES & SURFACE PREPARATION

General	Remove all contaminants per SSPC-SP 1. Refer to specific primer's Product Data Sheet for detailed requirements of the specified primer
Steel	Minimum Commercial Blast Clean per NACE No. 3/SSPC-SP 6 with 1.5-2.5 mil (37.5-62.5 micron) anchor profile for maximum protection. SSPC-SP2 or SP3 as minimum requirement.
Non-Ferrous Metals	For mild atmospheric environments, abrasive blast in accordance with SSPC-SP16 to achieve a dense angular profile of 1 -2 mils. Contact Carboline Technical Service for primer recommendations in more corrosive environments.

MIXING & THINNING

Mixing	Power mix Part A separately. Part B requires no mixing. Then combine power mix. DO NOT MIX PARTIAL KITS.
Thinning	Not normally required. May be thinned up to 10% (13 oz/gal) with Thinner #10 for spray, and Thinner 214, 215, or 238 for brush and roll.
Ratio	2.2:1 by volume: Part A to Part B
Pot Life	8 hours at 75°F (23°C) and less at higher temperatures. Material is moisture sensitive. If left uncovered for extended periods or under very high humidity conditions, check for and remove any skinning that may occur.

APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

Spray Application (General)	This is a high solids coating and may require adjustments in spray techniques. Wet film thickness is easily and quickly achieved. The following spray equipment has been found suitable and is available from manufacturers.
Airless Spray	Pump Ratio: 30:1 (min.) Volume Output: 2.5 gpm min. (11.5 l/min min.) Material Hose: ½" I.D. min. (12.5mm min.) Tip Size: 0.017-0.021" (0.43-0.53mm) Output Pressure: 1500-2000 psi (105-140kg/cm²)
Brush & Roller (General)	Multiple coats may be required to obtain desired appearance, recommended dry film thickness and adequate hiding. Avoid excessive re-brushing or re-rolling.

APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

Brush | Use a medium natural bristle brush.

Roller | Use a short to medium-nap mohair roller cover with solvent resistant core.

APPLICATION CONDITIONS

Condition	Material	Surface	Ambient	Humidity
Minimum	50°F (10°C)	35°F (2°C)	35°F (2°C)	20%
Maximum	90°F (32°C)	110°F (43°C)	110°F (43°C)	90%

Industry standards are for substrate temperatures to be 5°F (3°C) above the dew point. Protect from high humidity, dew and direct moisture contact until fully cured. Application and/or curing in humidities above maximum, or exposure to moisture from rain or dew may result in a loss of gloss and/or staining of the product.

CURING SCHEDULE

Surface Temp.	Dry to Recoat	Dry to Touch	Hard Cure
35°F (2°C)	24 Hours	8 Hours	30 Hours
60°F (16°C)	12 Hours	3 Hours	24 Hours
75°F (24°C)	6 Hours	2 Hours	18 Hours

These times are based on recommended coverage rates. Curing under low humidity conditions will extend times. Maximum recoat for this product is 30 days. After this period, it is best to degloss the surface by abrasive blasting or sanding prior to recoating.
Note: Like many coatings, this coating will develop full adhesion over the initial weeks following application.
*Hard Cure = Fingernail hard

CLEANUP & SAFETY

Cleanup | Use Thinner #2 or Acetone. In case of spillage, absorb and dispose of in accordance with local applicable regulations.

Safety | Read and follow all caution statements on this product data sheet and on the SDS for this product. Employ normal workmanlike safety precautions.

Ventilation | When used in enclosed areas, thorough air circulation must be used during and after application until the coating is cured. The ventilation system should be capable of preventing the solvent vapor concentration from reaching the lower explosion limit for the solvents used. User should test and monitor exposure levels to insure all personnel are below guidelines. If not sure or if not able to monitor levels, use MSHA/NIOSH approved supplied air respirator.

PACKAGING, HANDLING & STORAGE

Shelf Life | Part A: 24 months at 76°F (24°C)
Part B: 24 months at 76°F (24°C)

*Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.

PACKAGING, HANDLING & STORAGE

Storage Temperature & Humidity	40 -110°F (4°C-43°C) 0-90% Relative Humidity
Storage	Store Indoors. KEEP DRY. This product is solvent based and not affected by excursions below these published storage temperatures, down to 10°F, for a duration of no more than 14 days. Always inspect the product prior to use to make sure it is smooth and homogeneous when properly mixed.
Shipping Weight (Approximate)	1 Gallon Kit - 13 lbs (6 kg) 5 Gallon Kit - 67 lbs (30 kg)
Flash Point (Setaflash)	Part A: 96°F (36°C) Part B: 75°F (24°C) Thinner 10: 83°F (28°C) Thinner 214: 102°F (38°C) Thinner 215: 128°F (53°C) Thinner 238: 102°F (38°C) Thinner 2: 23°F (-5°C)

WARRANTY

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance, injuries or damages resulting from use. Carbolines sole obligation, if any, is to replace or refund the purchase price of the Carboline product(s) proven to be defective, at Carbolines option. Carboline shall not be liable for any loss or damage. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. All of the trademarks referenced above are the property of Carboline International Corporation unless otherwise indicated.

Product Case History

Twin Water Towers

LOCATION: Windom, MN, United States

DATE OF APPLICATION: September 2016

MARKET: Water Tanks

TYPE: Rehabilitation

OWNER: City of Windom

PROJECT SIZE: 820 Gallons

AREA COATED: Water Tanks

SUBSTRATE: Ferrous Metal (Carbon Steel)

EXPOSURE: Exterior Weathering - mild - urban or rural exposure

SURFACE PREP: Per Product Data Sheet

PRODUCTS: Carbozinc 859, Carboxane 2000

PROJECT DESCRIPTION:

Twin Water Towers

Windom, Minnesota

1 MM gallon Hydropillar

500,00 gallon Elevated Tank

COATING SELECTION EXPLANATION:

1 MM gallon Hydropillar, Carbozinc 859/Carboxane 2000 (spray applied)

500,00 gallon Elevated Tank, Carbozinc 859/Carboxane 2000 (brush and rolled)

Twin Water Towers

ADDITIONAL PHOTOS:

Carboxane® 2000
PRODUCT PERFORMANCE SUMMARY

WEATHERING PERFORMANCE–ACCELERATED WEATHERING (QUV-A)

Method	ASTM G53
System	Carboxane 2000
Exposure	Method D; UV-A-340 bulbs; Cycle: 8 hours UV/60ºC followed by 4 hours condensation @ 45ºC
Results (% Gloss Retention)	Initial Gloss: 72 At 4,000 hours: 99% At 8,000 hours: 80% At 12,000 hours: 53%
	For comparison purposes: **Level 3 Polyurethane (SSPC Paint 36)** At 3000 hours: 75% gloss retention

WEATHER PERFORMANCE - EMMAQUA

Method	Actual concentrated sunlight
System	Carboxane 2000
Exposure Intensity	25 months EMMAQUA exposure = 2866 MJ/m^2 Average 12 months of actual south Florida weathering = 280 MJ/m^2 Approximately 2.5 months of EMMAQUA exposure is equivalent to 12 months south Florida weathering
Duration	32 months
Results	At 12 months: 90% gloss retention At 25 months: 73% gloss retention At 32 months: 61% gloss retention

WEATHERING PERFORMANCE–ACCELERATED WEATHERING (QUV-B)

System	Carboxane 2000
Exposure	Method D; UV-B-313 bulbs; Cycle: 8 hours UV/60ºC followed by 4 hours condensation A@ 45ºC Duration: 1500 hours total
Results	65% gloss retention 1.25 dE color shift

WEATHERING PERFORMANCE – SOUTH FLORIDA

System	Carboxane 2000: 4 different colors (Grey, White, Green and Black)				
Exposure	10 years South Florida Direct Inland; 45º Facing South				
Evaluation	Panels evaluated for resistance to: Dirt Retention (ASTM D3274) Mildew (ASTM D3274) Chalking (ASTM D4214) Color Change (dE) (ASTM D2616)				
Results	**Color**	**Dirt Retention***	**Mildew***	**Chalking***	**Color (dE)**
	Grey (C705)	10/10	10/10	10/10	2.02
	White (0895)	10/10	9.75/10	10/10	1.16
	Green (E369)	10/10	10/10	10/10	7.36
	Black (C900)	10/10	10/10	10/10	0.80

*Rating out of 10 (10 being highest/best)

CORROSION RESISTANCE – CYCLIC EXPOSURE

Method	ISO 20340
Duration	25 cycles (4200 hours)
System	Carbozinc 859 Carboxane 2000
Surface Prep	SSPC-SP10
Results	Corrosion Undercutting: 0 mm Plane Area: No effects Adhesion: 853 psi (5.9 MPa)

CHEMICAL SPOT TESTING

Method	Chemical spot test (ASTM D1308)
System	Carboxane 2000
Exposure	1 hour @ 75ºF followed by 1 hour recovery
Results	Deionized water: Resistant; no effect Methyl ethyl ketone: Resistant no effect Mineral spirits: Resistant; no effect 5% Sulfuric acid: Resistant; no effect 5% Hydrochloric acid: Resistant; no effect Glacial acetic acid: Resistant; no effect 5% Sodium hydroxide: Resistant; no effect

HARDNESS

Method	ASTM D3363 – Pencil Hardness
System	Carboxane 2000
Results	Pencil Hardness: 3H

ADHESION (PNEUMATIC)

Method	ASTM D4541
System	Carbozinc 859 Carboxane 2000
Results	1362 psi (9.4 MPa)

ADHESION (WET)

Method	Total immersion in water at 75ºF for 7 days; followed by “X-cut” test
System	Carboxane 2000
Results	No failure after 7 days in liquid or vapor phases

FLEXIBILITY

Method	ASTM D522 – Conical mandrel
System	Carboxane 2000
Cure	a. 3 week ambient cure b. 24 hour cure at 140ºF
Results	a. >3/8” b. >9/16”

NOTE

The technical data presented in this document is accurate to the best of Carboline’s knowledge based on laboratory testing of the product(s) or system(s) described. Actual results in the field may vary depending on field conditions and application methods. The performance characteristics stated do not constitute a guarantee or warranty that the products will meet the stated results under all circumstances. Contact Carboline technical staff with questions.

Appendix I: Coating Sherwin-Williams Data Sheets

Protective & Marine Coatings
PRODUCT DATA SHEET

SHER-LOXANE® 800
TWO COMPONENT POLYSILOXANE

Revised: April 14, 2020

PRODUCT DESCRIPTION

SHER-LOXANE 800 is a versatile, high performance, two component polysiloxane (epoxy siloxane hybrid) that combines the properties of both a high performance epoxy and a polyurethane.

INTENDED USES

- Recommended for use on new construction, repair and field maintenance coating projects. It provides effective long-term corrosion control and weatherability.
- Can be applied directly over inorganic zincs
- <100 g/L VOC, no isocyanates
- 20°F (-5°C) cure

PRODUCT DATA

Finish: Gloss

Colors: Wide range of colors available

Volume Solids: 90% ± 3%, mixed

VOC: <100 g/L; 0.77 lb/gal (EPA Method 24)
12gms/kilo*
*content by weight from formulation, to satisfy EC Solvent Emissions Directive

Mix Ratio: 4:1 by volume

Typical Thickness:

Recommended Spreading Rate per coat:

	Minimum	Maximum
Wet mils (microns)	**5.0** (125)	**7.0** (175)
Dry mils (microns)	**4.0** (100)	**6.0** (150)
~Coverage sq ft/gal (m^2/L)	**240** (6.0)	**360** (9.0)
Theoretical coverage **sq ft/gal** (m^2/L) @ 1 mil / 25 microns dft	**1443** (35.4)	

NOTE: Brush or roll application may require multiple coats to achieve maximum film thickness and uniformity of appearance.

Shelf Life: 12 months, unopened
Store indoors at 40°F (4.5°C) to 100°F (38°C).

Flash Point:
Standard: 145°F (63°C), PMCC or SETA, mixed
Fast Cure: 154°F (68°C), PMCC or SETA, mixed

Reducer: Not required (MEK or Oxsol 100)

Clean Up: MEK, MIBK, MAK, Oxsol 100

Weight: 11.22 ± 0.2 lb/gal ; 1.3 Kg/L, mixed
may vary by color

Average Drying Times @ 5.0 mils wet (125 microns):

with Standard Hardener:

	77°F (25°C) *50% RH*	100°F (40°C) *50% RH*	120°F (50°C) *50% RH*
Touch:	3 hours	2.5 hours	2 hours
Handle:	6 hours	5 hours	4 hours
Recoat:			
minimum:	7 hours	6 hours	5 hours
maximum:	1 year	1 year	1 year
Cure to service:	7 days	4 days	3 days
Pot Life*:	2 hours	1.5 hours	1.5 hours
Sweat-in-time:		none required	

with Fast Cure Hardener:

	20°F (-5°C) *10% RH*	50°F (10°C) *40% RH*	77°F (25°C) *50% RH*
Touch:	12 hours	5 hours	1 hour
Handle:	75 hours	9 hours	2 hours
Recoat:			
minimum:	24 hours	9 hours	4 hours
maximum:	1 year	1 year	1 year
Cure to service:	14 days	7 days	7 days
Pot Life*:	8 hours	4 hours	2 hours
Sweat-in-time:		none required	

*Pot life is dependent upon paint temperature and mixed volume

If maximum recoat time is exceeded, abrade surface before recoating.
Drying time is temperature, humidity, and film thickness dependent.

SURFACE PREPARATION

Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.

Minimum recommended surface preparation:

Iron & Steel: Atmospheric: SSPC-SP6/NACE 3/ ISO8501-1:2007 Sa 2, 2-3 mil profile (50-75 microns)

Concrete & Masonry: Atmospheric: SSPC-SP13/NACE 6 - 4.3.1 or 4.3.2 or ICRI No. 310.2R CSP 2-3

Galvanized: Sweep blast to SSPC-SP16 with a blast profile of 1.5-3 mils (40-75 microns)

Protective & Marine Coatings
PRODUCT DATA SHEET

SHER-LOXANE® 800
TWO COMPONENT POLYSILOXANE

APPLICATION

Airless Spray
Pump.....35:1 minimum
Pressure.....2000 psi minimum (137 bar)
Tip .....015"-.019" (0.38-0.48 mm)

Conventional Spray
Gun .....Binks 95
Fluid Nozzle 67
Air Nozzle.....667
Atomization Pressure.....60 psi (4 bar)
Fluid Pressure.....20 psi (0.7 bar)

Plural Component Spray
Consult your SW sales or technical service representative

Brush
Brush.....Natural Bristle
Note: Required film thickness may not be achieved in one coat

Roller
Cover .....3/8" woven with solvent resistant core

If specific application equipment is not listed above, equivalent equipment may be substituted.

RECOMMENDED SYSTEMS

Dry Film Thickness / ct.		Mils	(Microns)
Steel, Atmospheric, per ISO 12944-6 (2018), C5M			
2 Cts.	Sher-Loxane 800	4.7	(120)
Steel, Inorganic Zinc/Polysiloxane Topcoat, Atmospheric			
1 Ct.	Zinc Clad II (85)	2.0-4.0	(50-100)
1 Ct.**	Sher-Loxane 800	4.0-6.0	(100-150)
Steel, Organic Zinc/Polysiloxane, Atmospheric			
1 Ct.	Zinc Clad IV (85)	3.0-5.0	(75-125)
1 Ct.	Sher-Loxane 800	4.0-6.0	(100-150)
Steel, Atmospheric			
1*-2 Cts.	Sher-Loxane 800	4.0-6.0	(100-150)
Steel, Atmospheric			
1 Ct.	Macropoxy 267	5.0	(125)
1 Ct.	Sher-Loxane 800	4.0-6.0	(100-150)
Steel, Atmospheric			
1 Ct.	Macropoxy 646	5.0-10.0	(125-250)
1 Ct.	Sher-Loxane 800	4.0-6.0	(100-150)
Steel, Inorganic Zinc/Epoxy/Polysiloxane, Atmospheric			
1 Ct.	Zinc Clad II (85)	2.0-4.0	(50-100)
1 Ct.	Macropoxy 646	5.0-10.0	(125-250)
1 Ct.	Sher-Loxane 800	4.0-6.0	(100-150)
Steel, Epoxy/Epoxy/Polysiloxane, Atmospheric			
1 Ct.	Macropoxy 646	5.0-10.0	(125-250)
1 Ct.	Macropoxy 646	5.0-10.0	(125-250)
1 Ct.	Sher-Loxane 800	4.0-6.0	(100-150)

Dry Film Thickness / ct. — Mils — (Microns)

Steel, Atmospheric, per ISO 12944-6 (2018), C5M
2 Cts. Sher-Loxane 800 — 4.7 — (120)

Steel, Inorganic Zinc/Polysiloxane Topcoat, Atmospheric
1 Ct. Zinc Clad II (85) — 2.0-4.0 — (50-100)
1 Ct.** Sher-Loxane 800 — 4.0-6.0 — (100-150)
**Use a mist coat/full coat technique. Up to 10% MEK or 5% Oxsol 100 reduction is recommended.

Steel, Organic Zinc/Polysiloxane, Atmospheric
1 Ct. Zinc Clad IV (85) — 3.0-5.0 — (75-125)
1 Ct. Sher-Loxane 800 — 4.0-6.0 — (100-150)

Steel, Atmospheric
1*-2 Cts. Sher-Loxane 800 — 4.0-6.0 — (100-150)
*One coat acceptable in light industrial environments

Steel, Atmospheric
1 Ct. Macropoxy 267 — 5.0 — (125)
1 Ct. Sher-Loxane 800 — 4.0-6.0 — (100-150)

Steel, Atmospheric
1 Ct. Macropoxy 646 — 5.0-10.0 — (125-250)
1 Ct. Sher-Loxane 800 — 4.0-6.0 — (100-150)

Steel, Inorganic Zinc/Epoxy/Polysiloxane, Atmospheric
1 Ct. Zinc Clad II (85) — 2.0-4.0 — (50-100)
1 Ct. Macropoxy 646 — 5.0-10.0 — (125-250)
1 Ct. Sher-Loxane 800 — 4.0-6.0 — (100-150)

Steel, Epoxy/Epoxy/Polysiloxane, Atmospheric
1 Ct. Macropoxy 646 — 5.0-10.0 — (125-250)
1 Ct. Macropoxy 646 — 5.0-10.0 — (125-250)
1 Ct. Sher-Loxane 800 — 4.0-6.0 — (100-150)

The systems listed above are representative of the product's use, other systems may be appropriate.

APPLICATION CONDITIONS

Recommended Temperature (air, surface, material):

with Standard Hardener: 77°F (25°C), 50% RH minimum
120°F (50°C), 50% RH maximum
with Fast Cure Hardener: 20°F (-5°C), 10% RH minimum
77°F (25°C), 50% RH maximum
At least 5°F (2.8°C) above dew point

Relative humidity: 10%-85%
Note: <10% RH will increase dry times; >85% will decrease dry times

APPROVALS

- Meets USDA requirement for incidental contact
- Two coats of Sher-Loxane 800 @ 120 microns (4.7 mils) dft per coat applied direct-to-metal is in full accordance with the requirements of ISO 12944-6 (2018), C5M.

ADDITIONAL NOTES

Tint 150% tint strength with Maxitoner Colorants only into Part A. Do not exceed 15 oz/gal. Five minutes minimum mixing on a mechanical shaker is required for complete mixing of color.

Stripe coat all crevices, welds, and sharp angles to prevent early failure in these areas.

Do not mix previously catalyzed material with new.

HEALTH AND SAFETY

Refer to the SDS sheet before use.
Published technical data and instructions are subject to change without notice. Contact your Sherwin-Williams representative for additional technical data and instructions.

WARRANTY

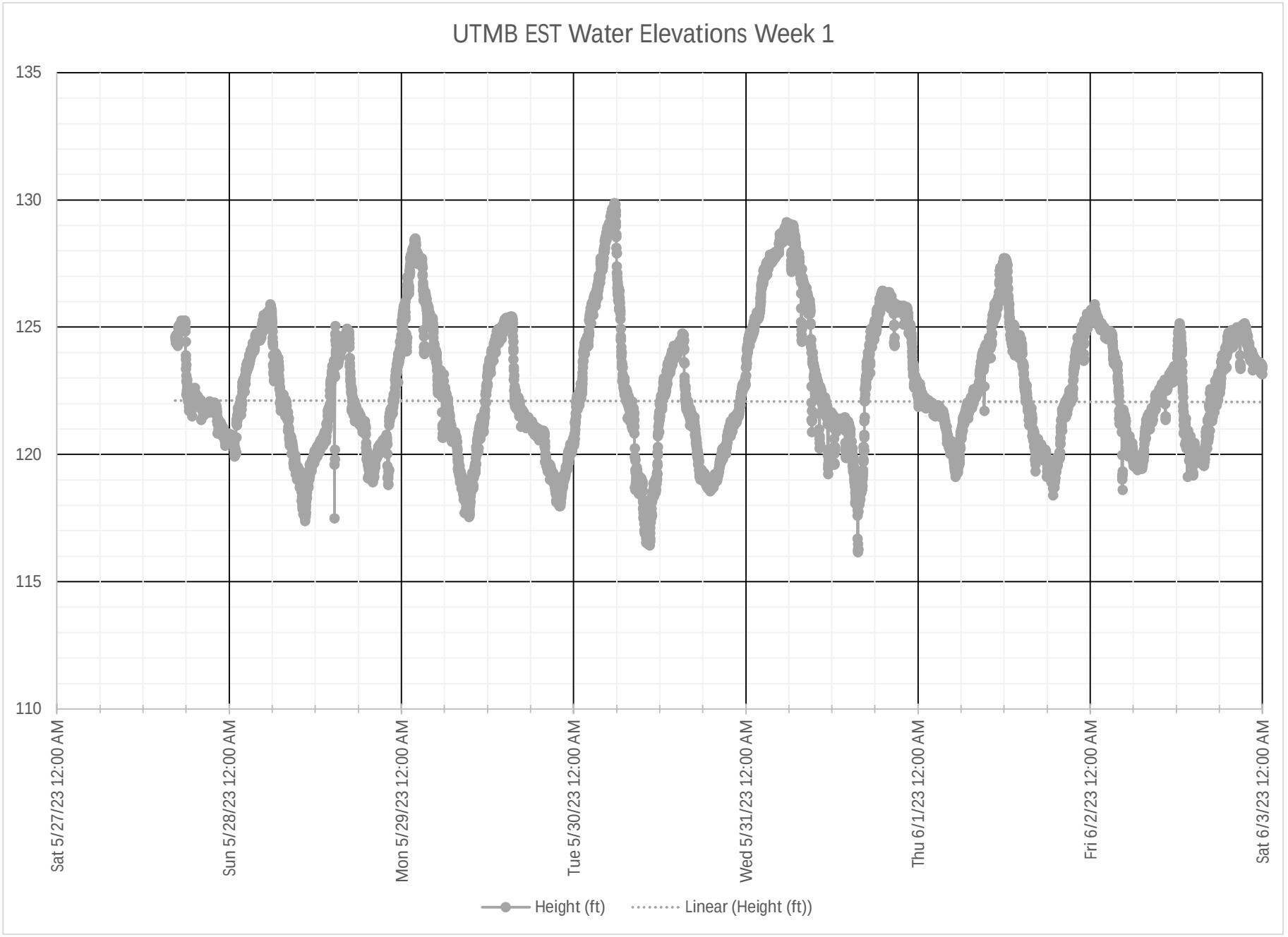
The Sherwin-Williams Company warrants our products to be free of manufacturing defects in accord with applicable Sherwin-Williams quality control procedures. Liability for products proven defective, if any, is limited to replacement of the defective product or the refund of the purchase price paid for the defective product as determined by Sherwin-Williams. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY SHERWIN-WILLIAMS, EXPRESSED OR IMPLIED, STATUTORY, BY OPERATION OF LAW OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

DISCLAIMER

The information and recommendations set forth in this Product Data Sheet are based upon tests conducted by or on behalf of The Sherwin-Williams Company. Such information and recommendations set forth herein are subject to change and pertain to the product offered at the time of publication. Consult your Sherwin-Williams representative to obtain the most recent Product Data Sheet.

Appendix J: Pressure Data

week 1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135
130
125
120
115
110
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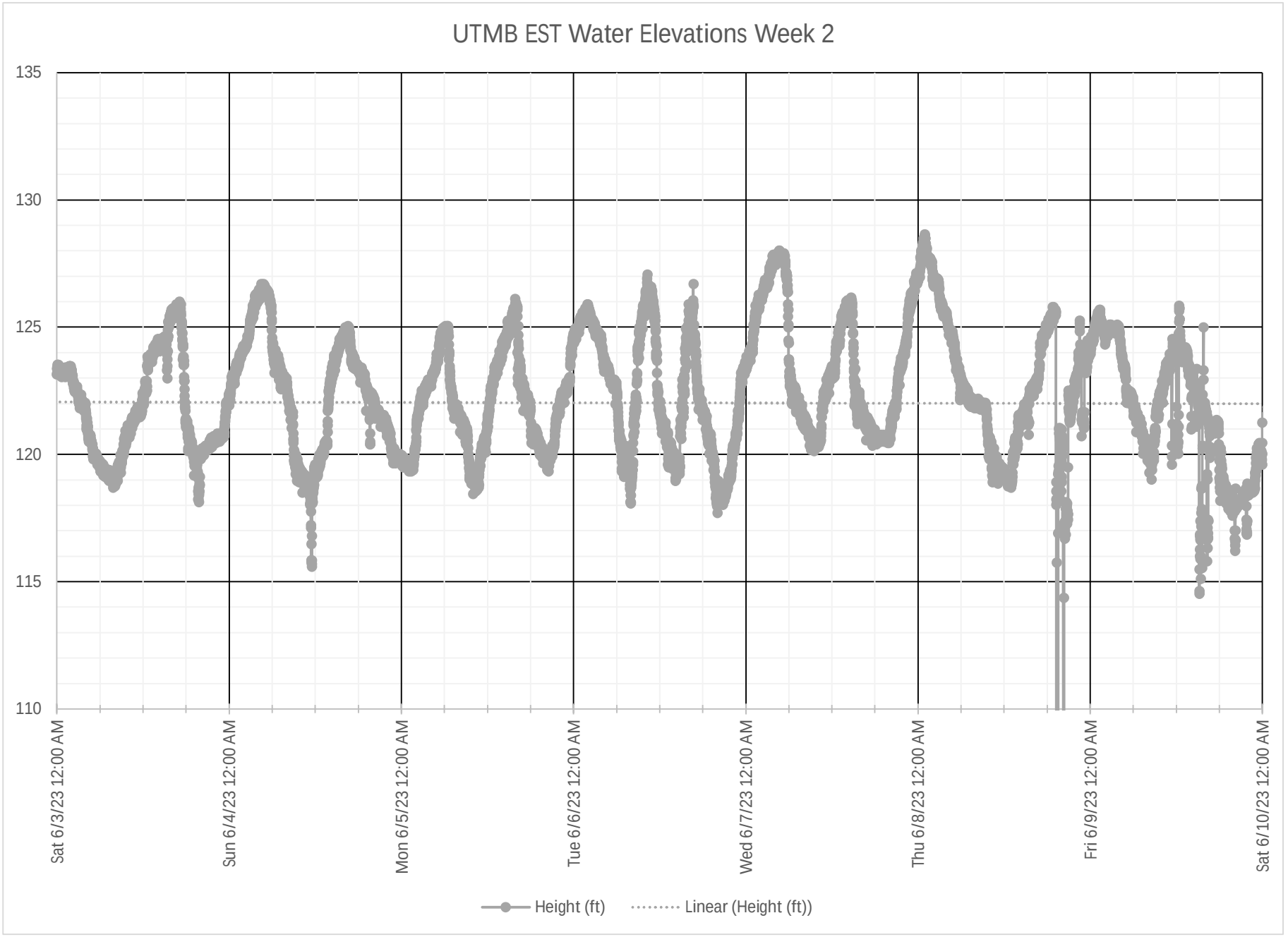
Sun 5/28/23 12:00 AM
Mon 5/29/23 12:00 AM
Tue 5/30/23 12:00 AM
Wed 5/31/23 12:00 AM
Thu 6/1/23 12:00 AM
Fri 6/2/23 12:00 AM
Sat 6/3/23 12:00 AM
Height (ft)
Linear (Height (ft))

week 2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135
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120
115
110
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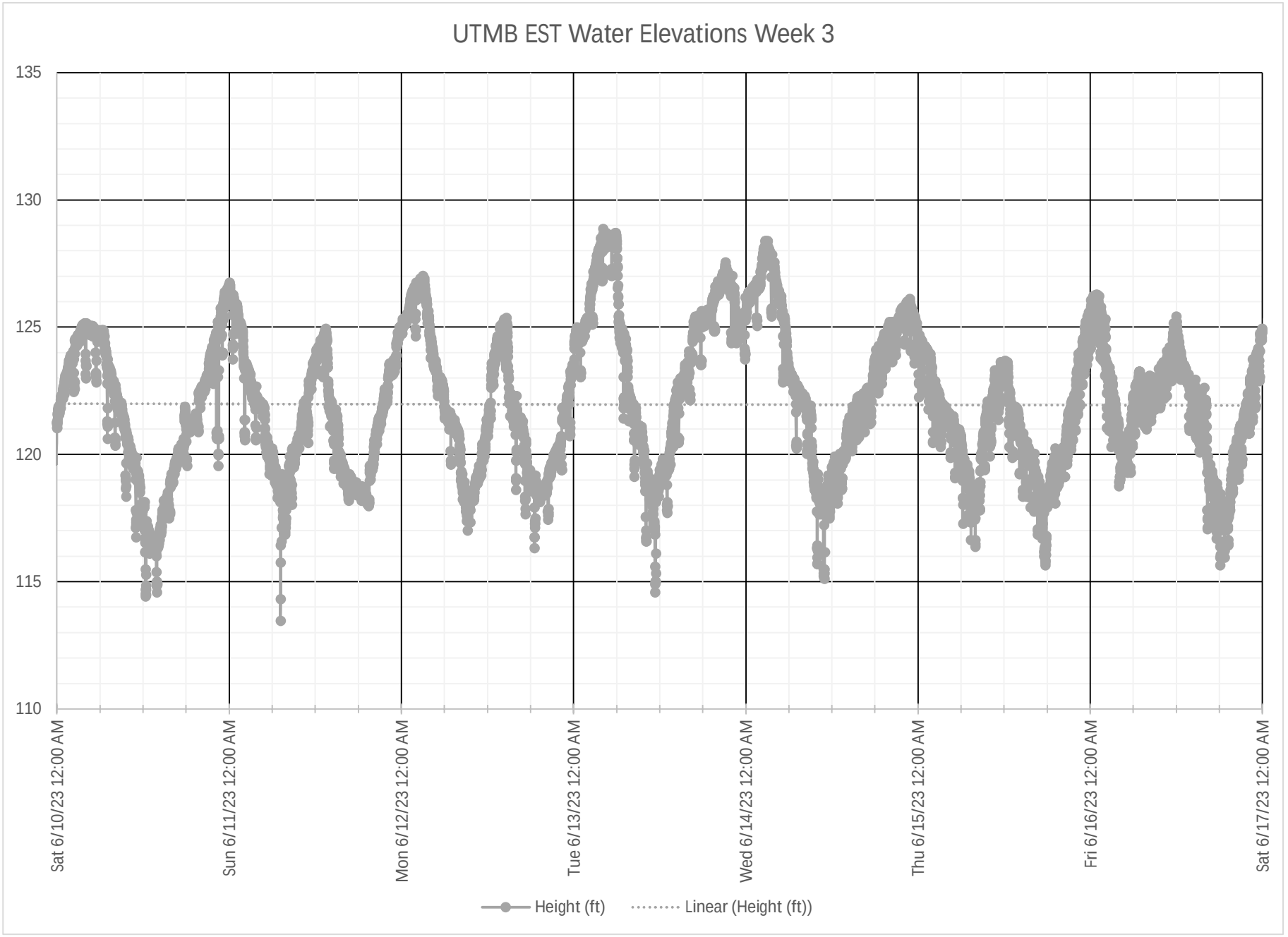
Sun 6/4/23 12:00 AM
Mon 6/5/23 12:00 AM
Tue 6/6/23 12:00 AM
Wed 6/7/23 12:00 AM
Thu 6/8/23 12:00 AM
Fri 6/9/23 12:00 AM
Sat 6/10/23 12:00 AM
Height (ft)
Linear (Height (ft))

week 3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135
130
125
120
115
110
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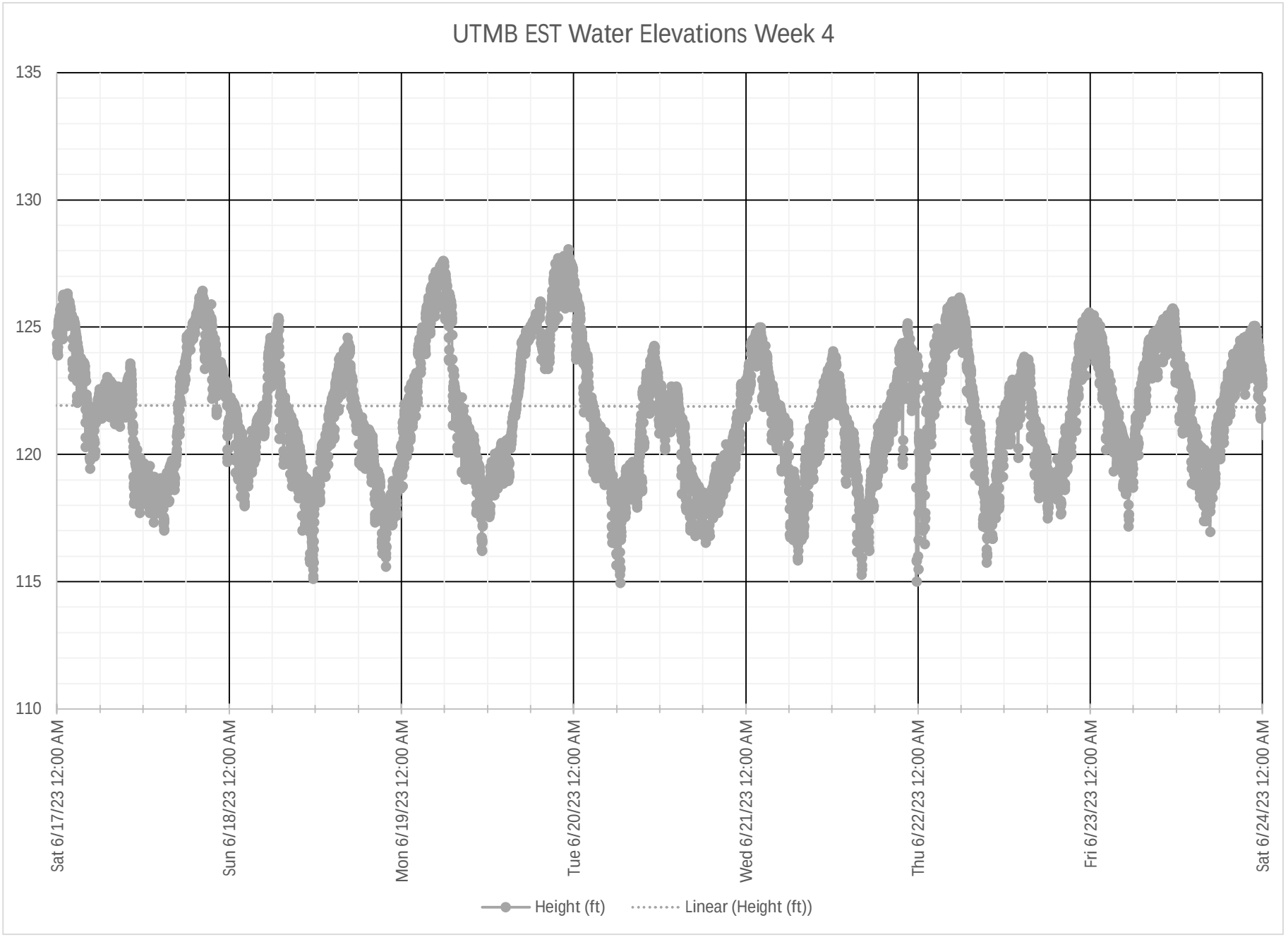
Sun 6/11/23 12:00 AM
Mon 6/12/23 12:00 AM
Tue 6/13/23 12:00 AM
Wed 6/14/23 12:00 AM
Thu 6/15/23 12:00 AM
Fri 6/16/23 12:00 AM
Sat 6/17/23 12:00 AM
Height (ft)
Linear (Height (ft))

week 4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135
130
125
120
115
110
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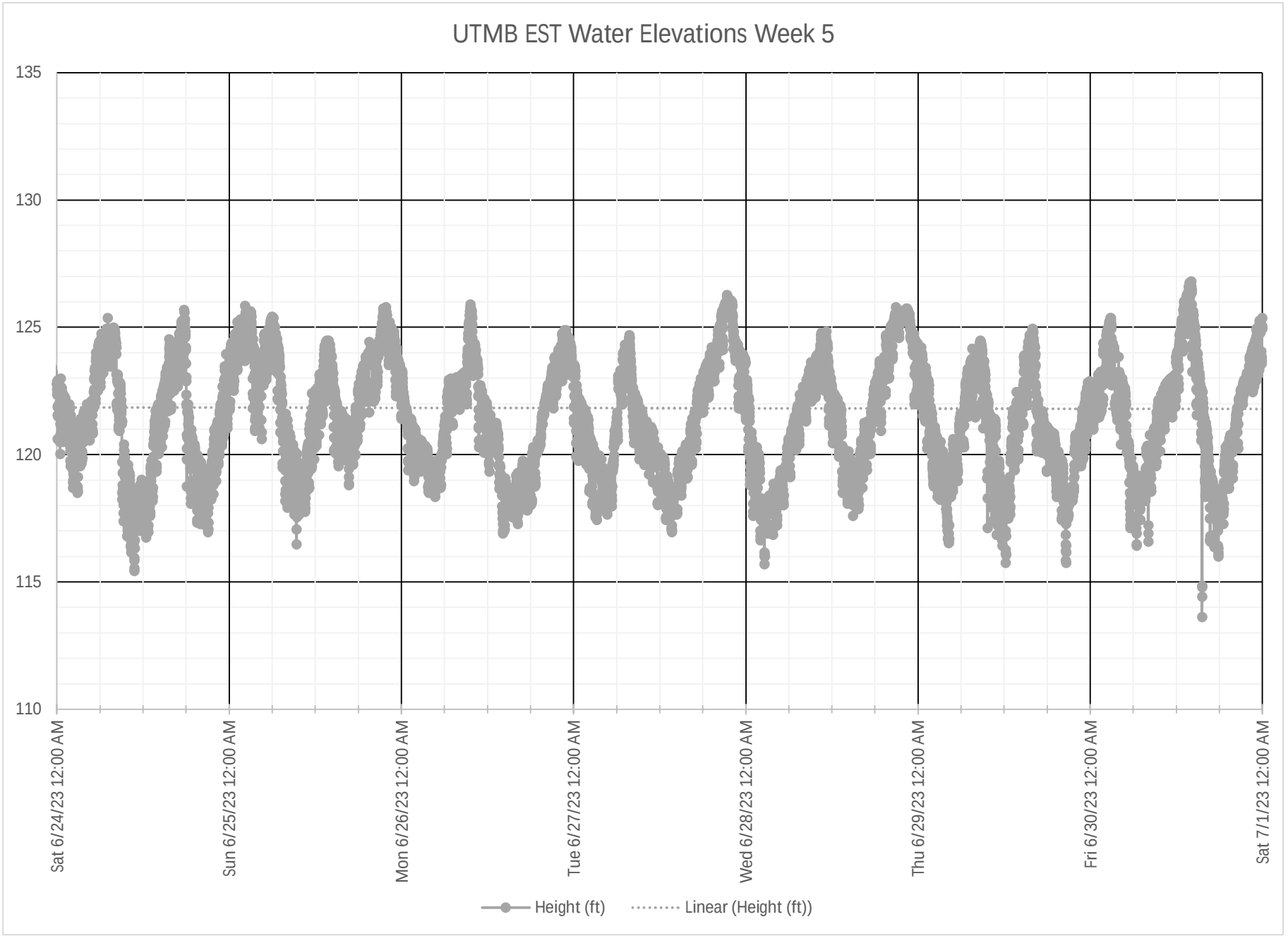
Sun 6/18/23 12:00 AM
Mon 6/19/23 12:00 AM
Tue 6/20/23 12:00 AM
Wed 6/21/23 12:00 AM
Thu 6/22/23 12:00 AM
Fri 6/23/23 12:00 AM
Sat 6/24/23 12:00 AM
Height (ft)
Linear (Height (ft))

week 5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130
125
120
115
110
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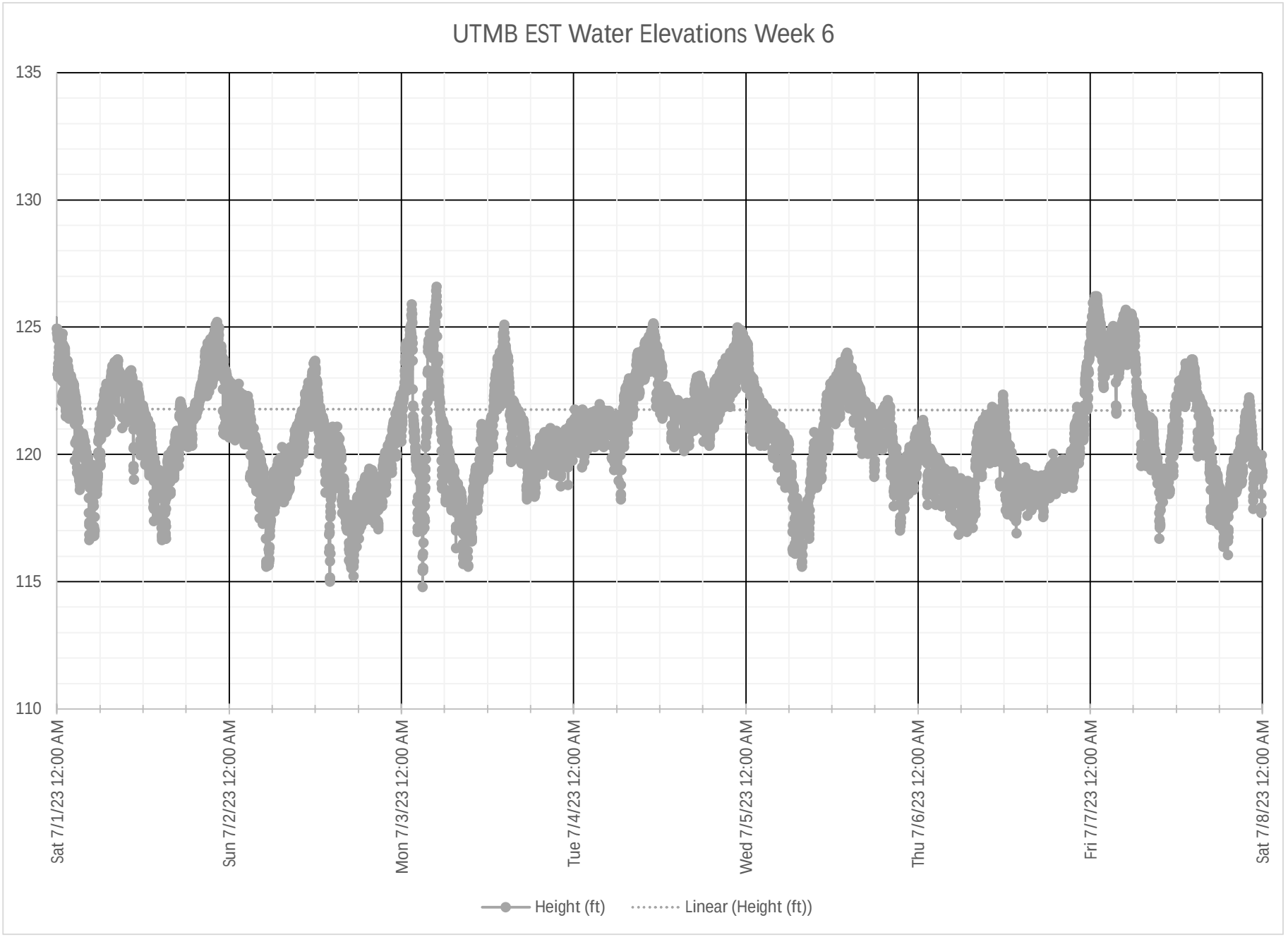
Height (ft)
Linear (Height (ft))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130
125
120
115
110
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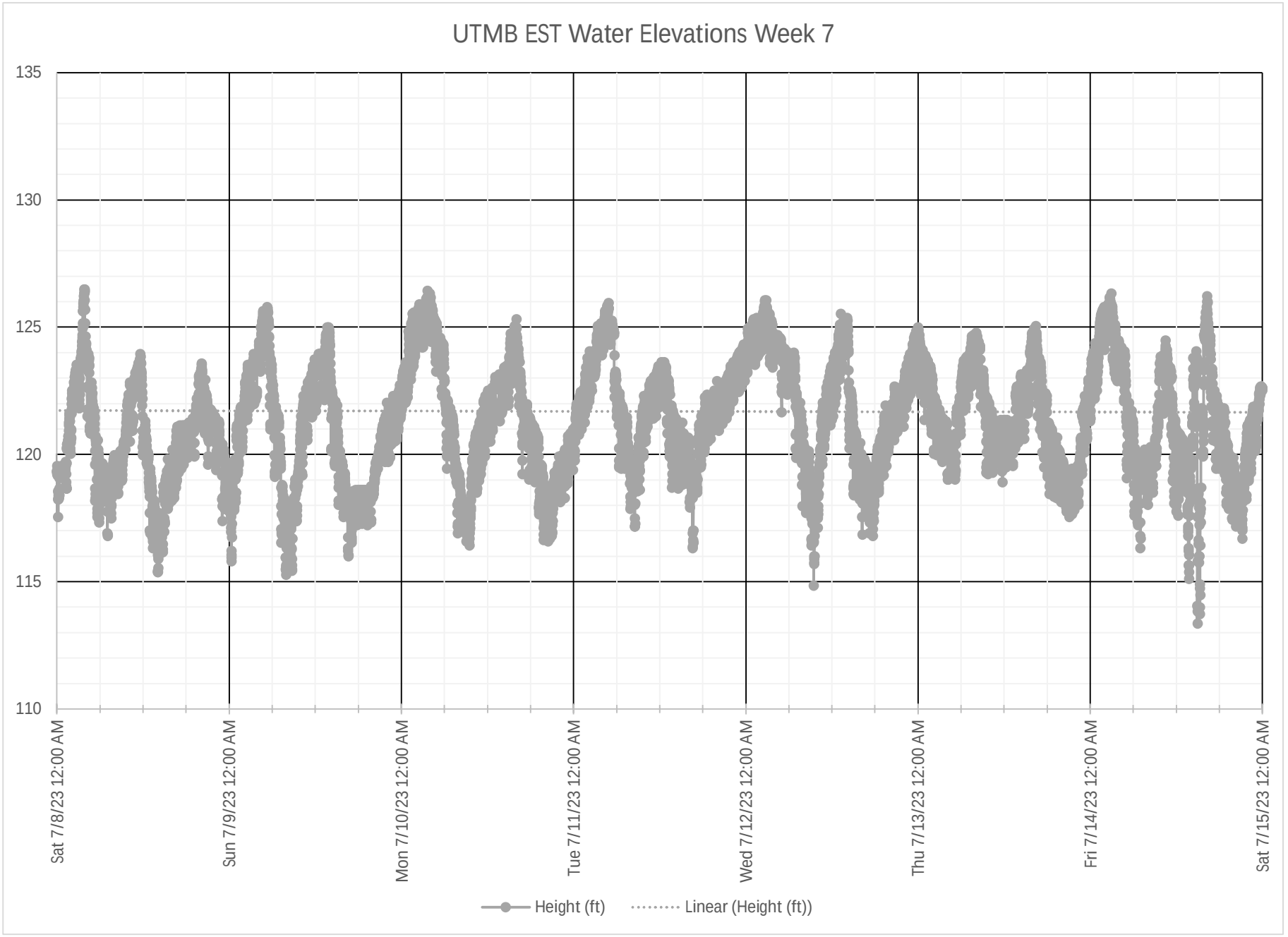
Wed 7/5/23 12:00 AM
Thu 7/6/23 12:00 AM
Fri 7/7/23 12:00 AM
Sat 7/8/23 12:00 AM
Height (ft)
Linear (Height (ft))

week 7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130
125
120
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110
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Wed 7/12/23 12:00 AM
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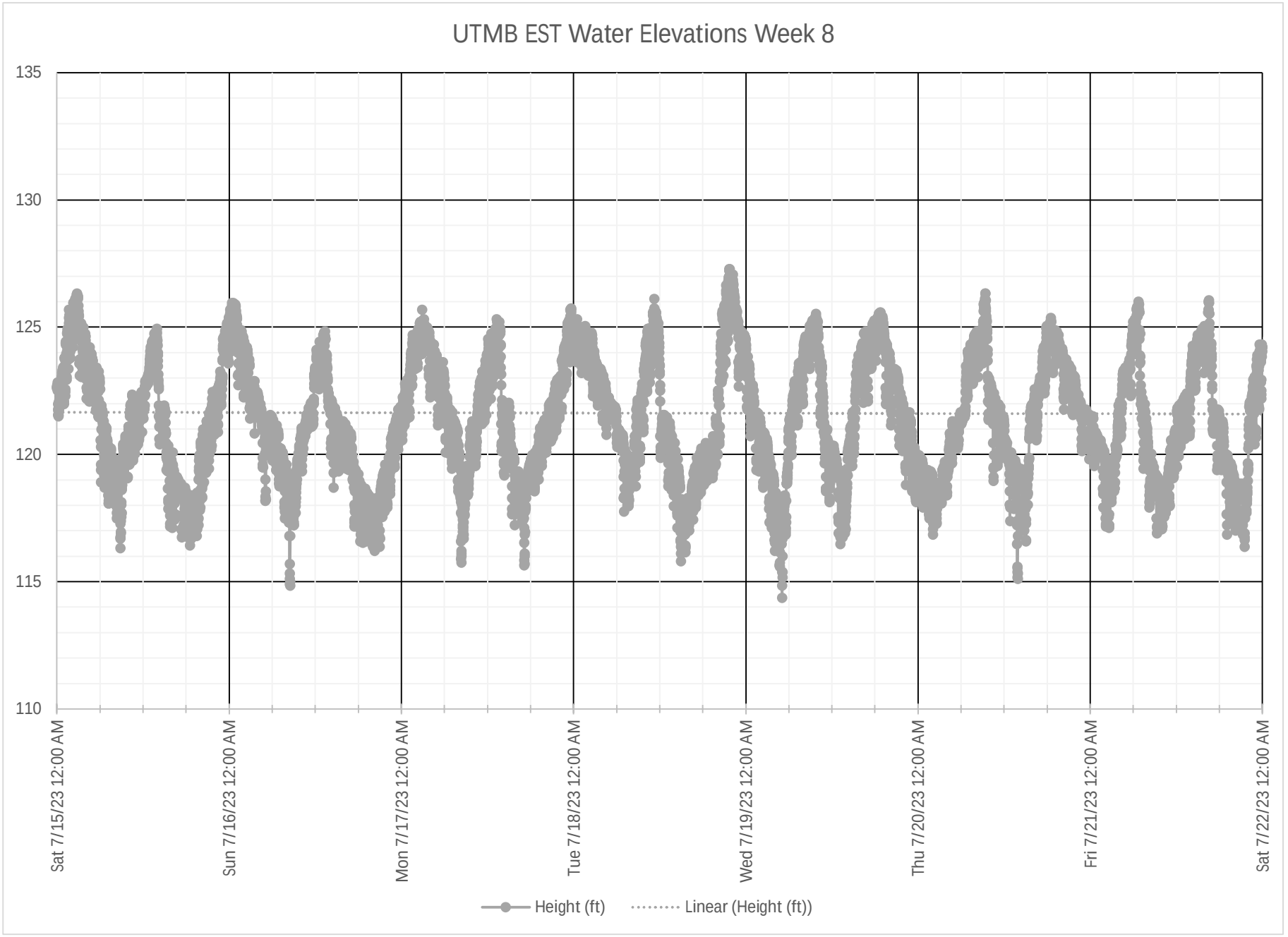
Sat 7/15/23 12:00 AM
Height (ft)
Linear (Height (ft))

week 8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125
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115
110
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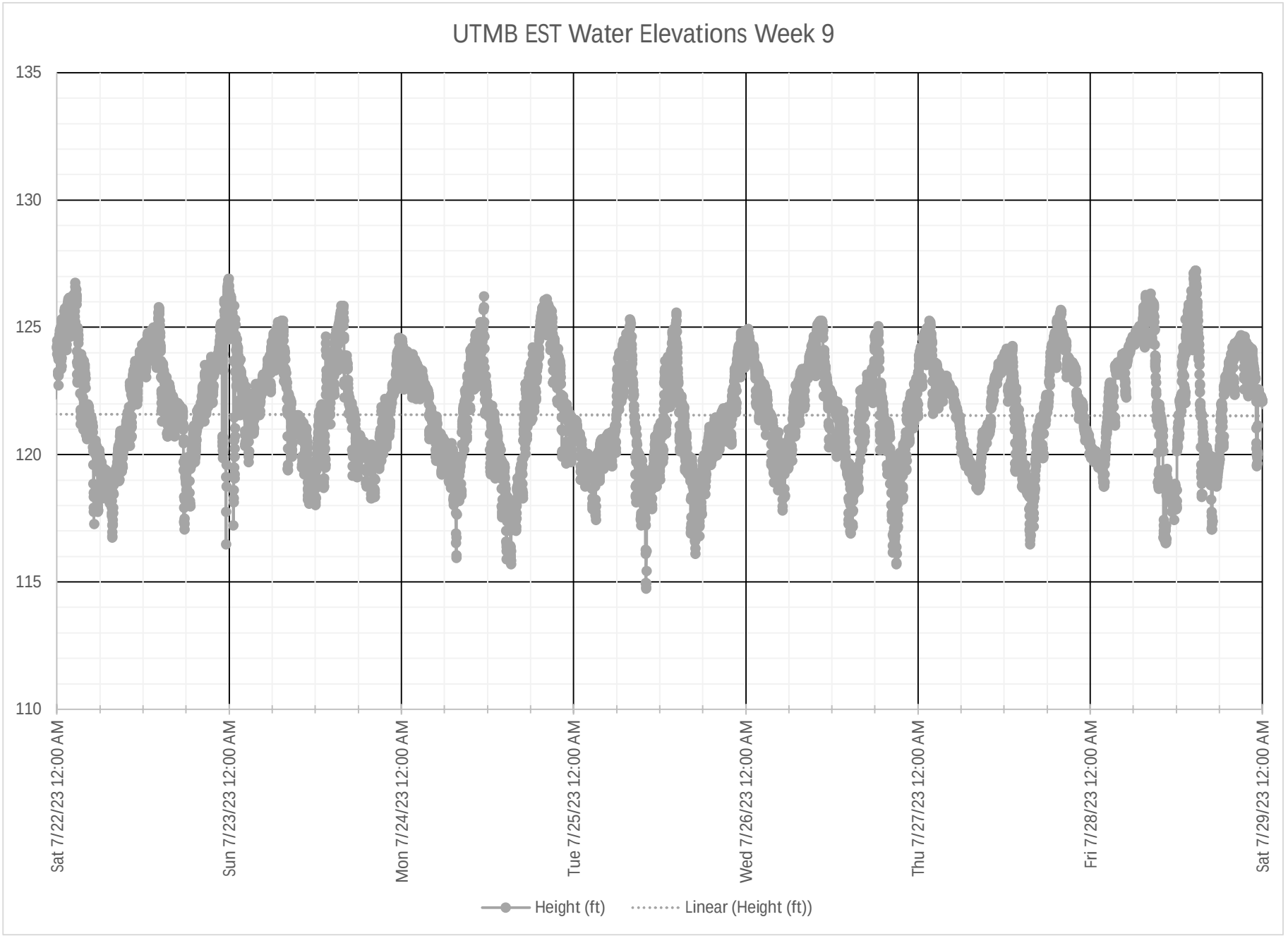
Height (ft)
Linear (Height (ft))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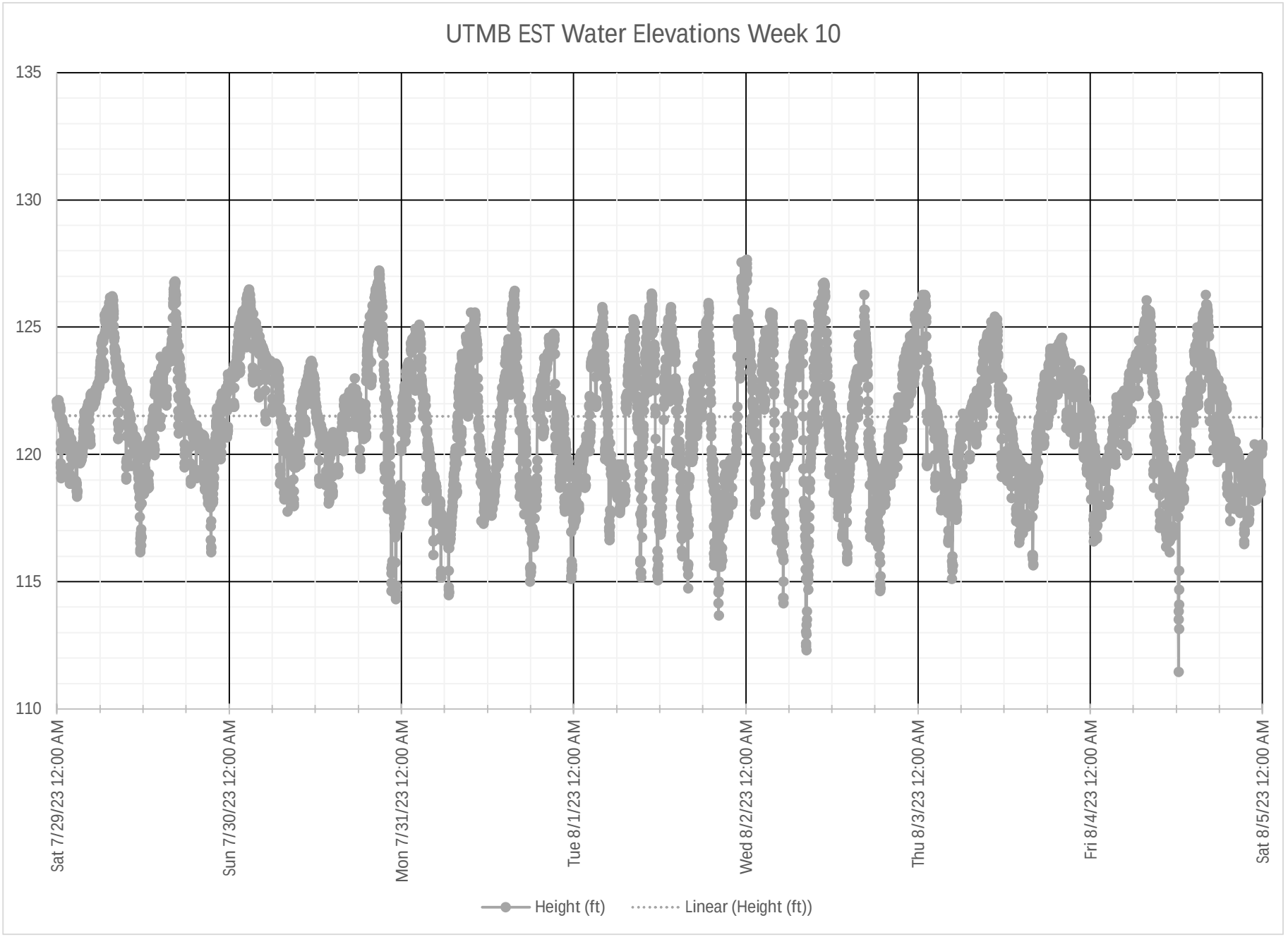
Height (ft)
Linear (Height (ft))


UTMB EST Water Elevations Week 10
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125
120
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Mon 7/31/23 12:00 AM
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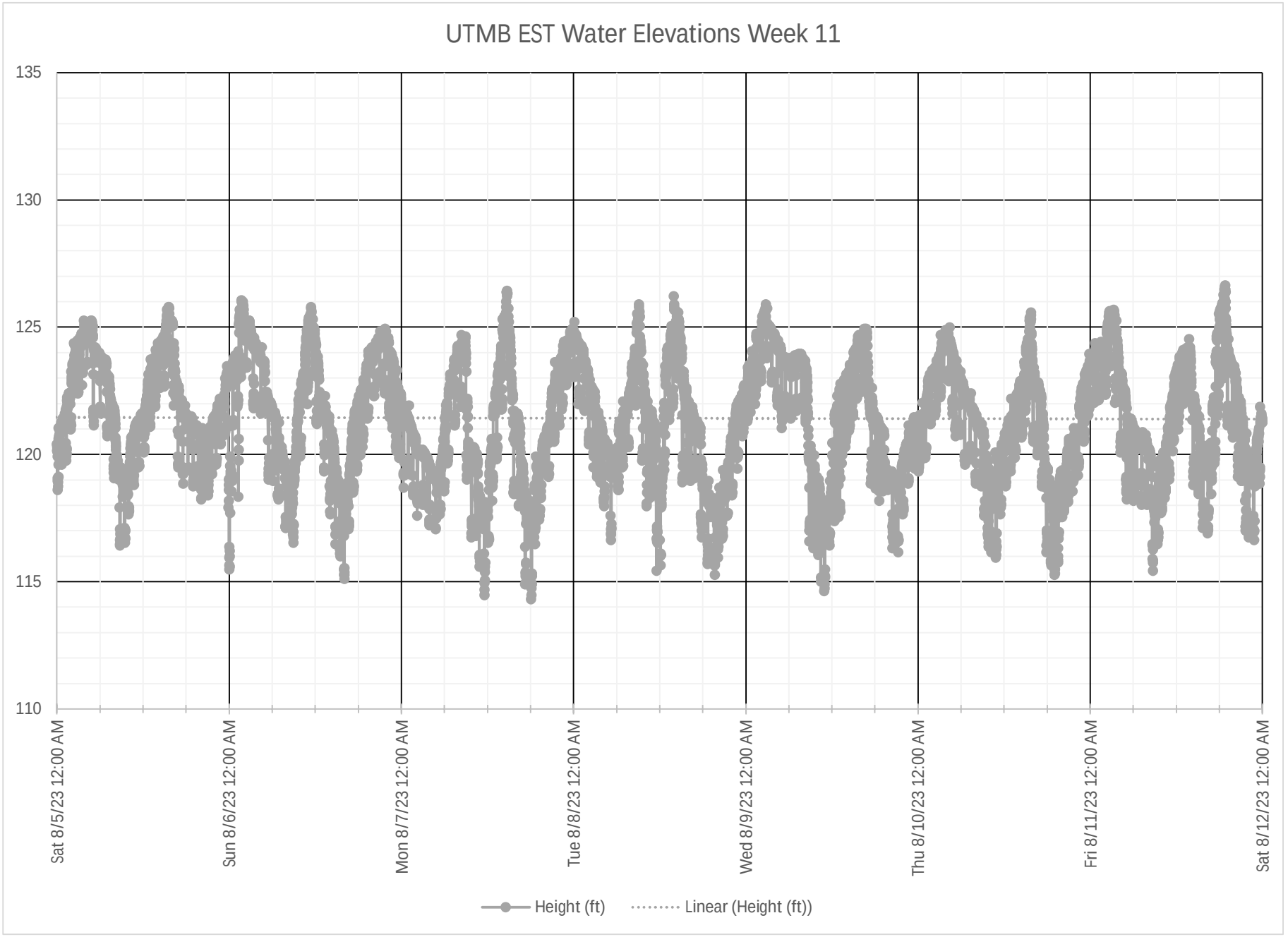
Sat 8/5/23 12:00 AM
Height (ft)
Linear (Height (ft))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125
120
115
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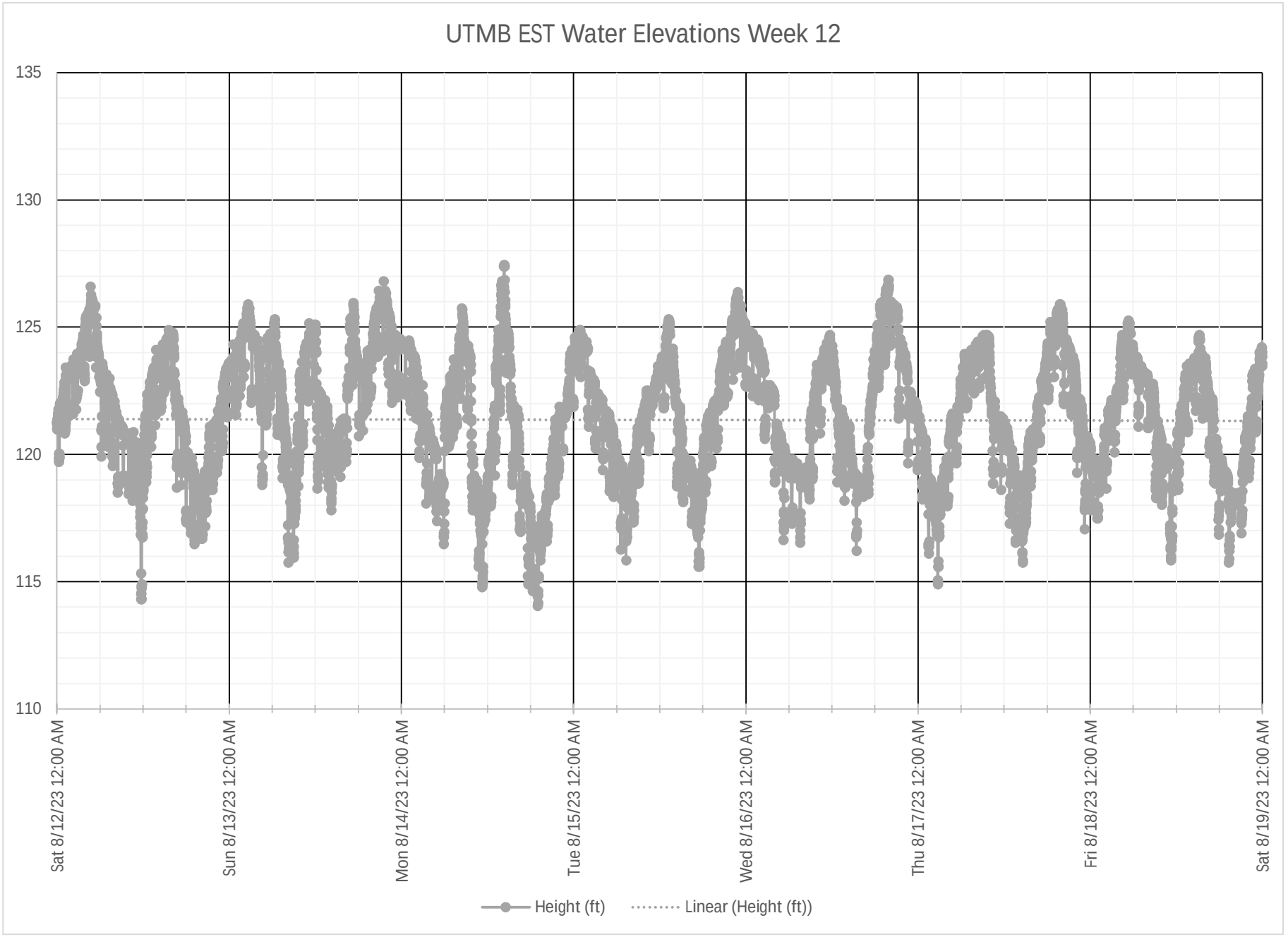
Height (ft)
Linear (Height (ft))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120
115
110
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Tue 8/15/23 12:00 AM
Wed 8/16/23 12:00 AM
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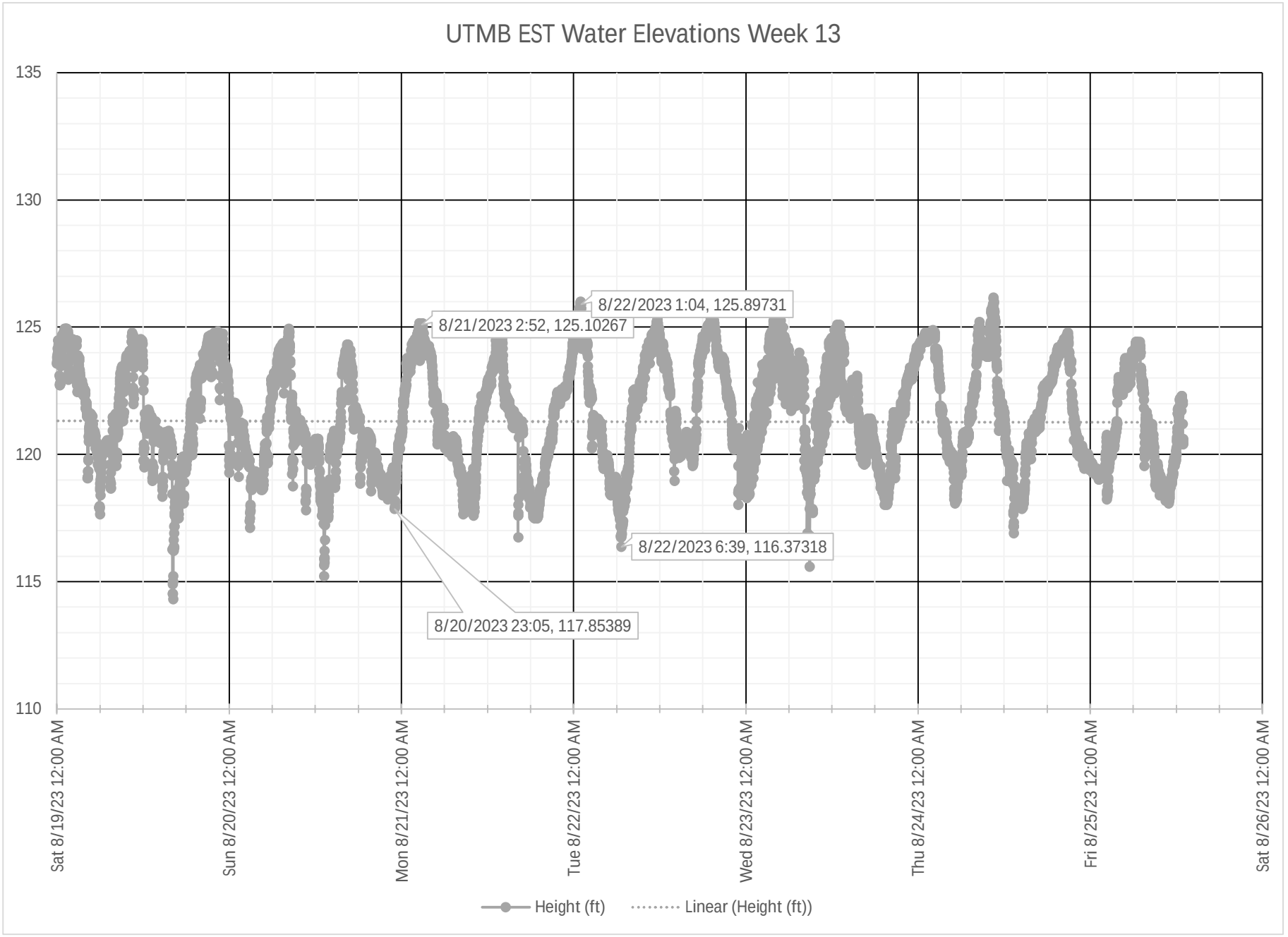
Fri 8/18/23 12:00 AM
Sat 8/19/23 12:00 AM
Height (ft)
Linear (Height (ft))

week 13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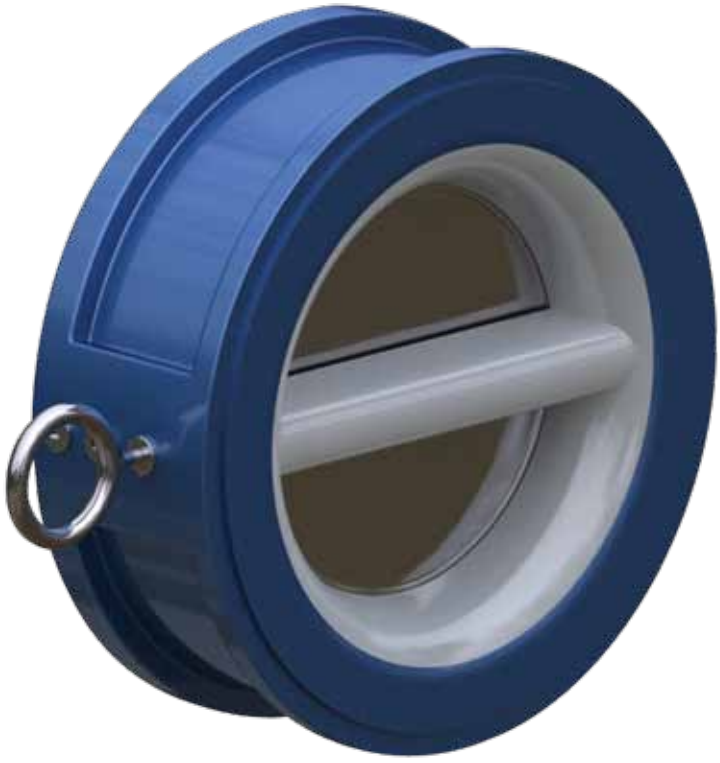
Wed 8/23/23 12:00 AM
Thu 8/24/23 12:00 AM
Fri 8/25/23 12:00 AM
Sat 8/26/23 12:00 AM
Height (ft)
Linear (Height (ft))

Appendix K: Check Valve

BULLETIN 9000
OCTOBER 2011

DeZURIK
APCO | WILLAMETTE

APCO DOUBLE DOOR CHECK VALVES



Series 9000/9000L/9400

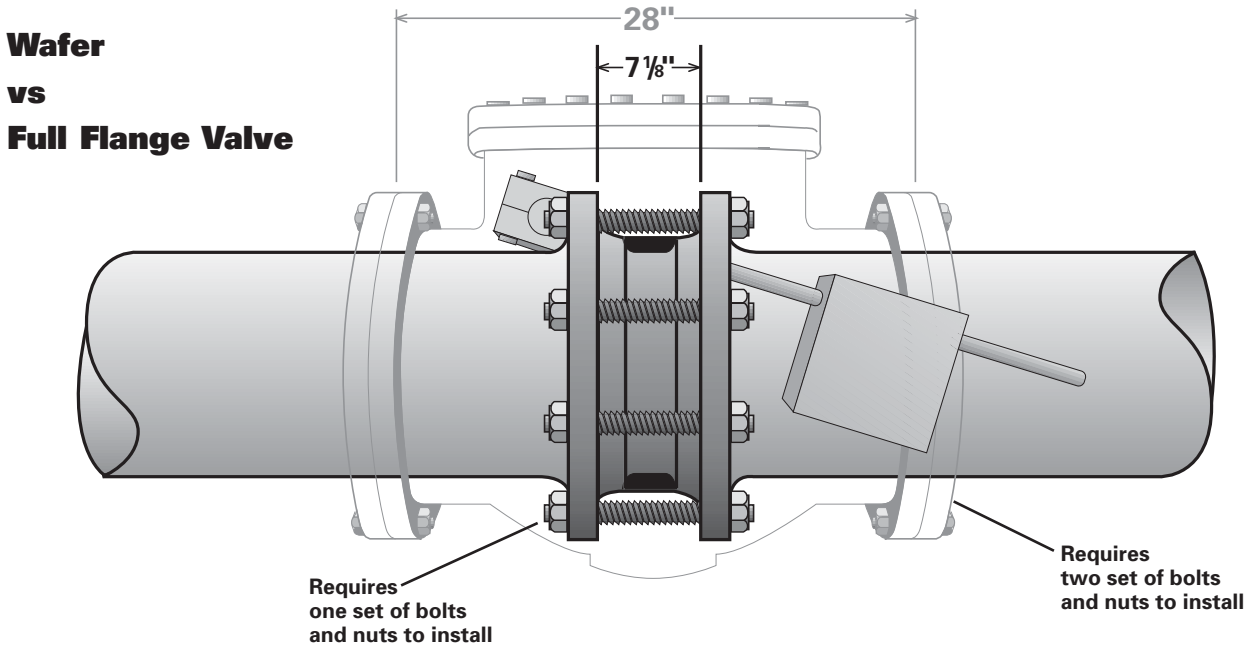
 © 2011 DeZURIK, Inc.

The Advantages of Double Door Check Valves

This type of check valve is widely specified and has been successfully used for many years in refineries and petrochemical plants. Reasons for its success include the unique short face to face length, low purchase cost and non-slam principle of operation.

It is obvious why APCO Double Door Check Valves (DDCV) are the most economical to purchase and install by the following comparison.

- A 12" (300mm) Swing Check Valve of conventional design (as manufactured by APCO), Model 6012, 125# class has a face to face length of 28" (700mm) A 12" (300mm) APCO DDCV, Model 9012, 125# class has a face to face length of 7⅛" (181mm).
- The 12" (300mm) swing check valve 125# class weighs 900 lbs (408kg). The 12" (300mm) APCO DDCV 125# class weighs 125 lbs (57kg).



DDCVs have an excellent performance reputation in refineries, petrochemical and process plants. It should be understood that operating conditions in refineries, petrochemical and process plants are unique. Because they rarely shut down, DDCVs are used throughout the plant. Piping in these plants is usually designed to withstand the fast closing action of double door check type valves. When considering the DDCV for anything other than refineries, petrochemical or gas liquification plants, it is important to note that the DDCV is fast closing but not silent.

No single check valve is all serving. For example, the DDCV is excellent for refinery and petrochemical media, but it would be a poor selection for sewage media, due to the obstruction in the flow area, etc. DDCVs are available in various styles and materials for pressures up to 2500# class, sizes to 72" (1800mm).

For more comparison information about various type check valves, see Bulletin #769 - "APCO Check Valve Guide"

Factory Mutual System Approved

Series 9000

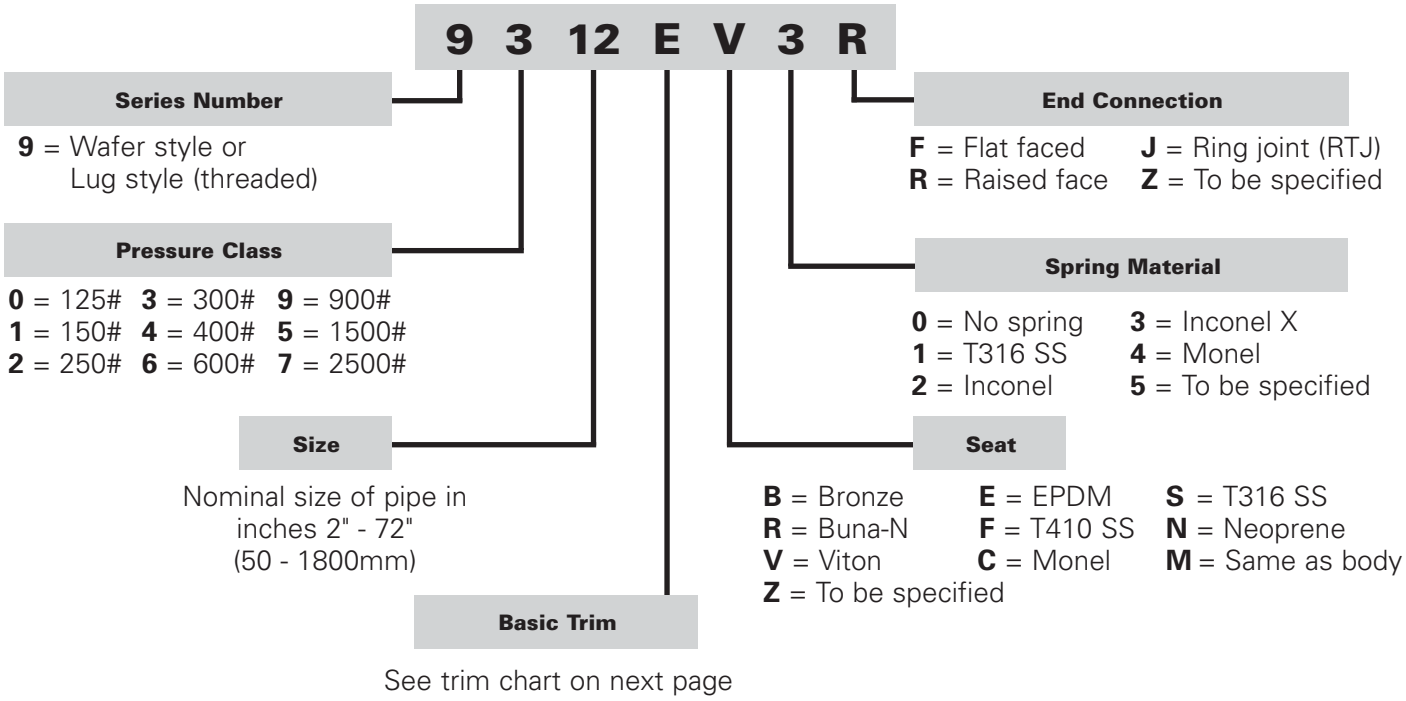
ISO dimensions available

Materials Designation Index

Series 9000

APCO Double Door Check Valves can be easily identified or specified by using the following index:

Example Specification: Series 9000 DDCV, 300 lb. raised face ends, 12" (300mm) size, carbon steel body, T316 stainless steel doors, hinge pin and stop pin with viton seat, Inconel X spring



Basic Trim

Trim A 2" - 24" (50 - 600mm)	Ductile Iron Body – T304 Stainless Steel Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
30" – 72" (750 - 1800mm)	Ductile Iron Body – Ductile Iron Doors – Stainless Steel Faced – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim B 2" - 12" (50 - 300mm)	Cast Iron Body – Cast Steel Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
14" – 72" (350 - 1800mm)	Cast Iron Body – Ductile Iron Doors – Nickel Faced – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim C	Carbon Steel Body and Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim D	Carbon Steel Body – 410 Stainless Steel Doors – T316 Stainless Steel Hinge Pin and Stop Pin. Note: Body to Have 410 Stainless Steel Overlay in Seating Area Unless Otherwise Specified.
Trim E	Carbon Steel Body – T316 Stainless Steel Doors, Hinge Pin and Stop Pin. Note: Body to Have T316 Stainless Steel Overlay in Seating Area Unless Otherwise Specified.
Trim F	410 Stainless Steel Body, Doors, Hinge Pin and Stop Pin.
Trim G	T316 Stainless Steel Body, Doors, Hinge Pin and Stop Pin.
Trim H	Cast Iron Body, T316 Stainless Steel Doors, Hinge Pin and Stop Pin. Note: 14" (350Mm) and Larger to Have Ductile Iron Doors with Stainless Steel Facing.
Trim I	Ductile Iron Body and T316 Stainless Steel Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim J	Ductile Iron Body – Aluminum Bronze Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim K	Aluminum Bronze Body and Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim L	Aluminum Body and Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim M	Carbon Steel Body – Monel Doors, Hinge Pin and Stop Pin.
Trim N	Alloy Steel ASTM A217 – Grades - C5 - WC6 - WC9 or C12 – 410 Stainless Steel Hinge Pin and Stop Pin. Please specify grade.
Trim P	Nickel Aluminum Bronze Body and Doors – Monel Hinge Pin and Stop Pin.
Trim Q	316 L Stainless Steel Body and Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim R	317 Stainless Steel Body and Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim S	Duplex Stainless Steel Body and Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
Trim T	254 SMO Stainless Steel Body and Doors – T316 Stainless Steel Hinge Pin and Stop Pin.
Additional Trim (Z)	Contact Factory for Optional Materials

Note: Overlays for trim D & E
T410SS - T316SS - overlay available

All valves conform to A.P.I. 594 dimensional standards and are designed for mounting between A.N.S.I. flanges.
**** All facing is for seating area only.**

Trim Material Specification

Body And Door (Cast Parts)

Cast Iron . . . . . ASTM A126 GR. B
Ductile Iron . . . . . ASTM A536 GR. 65-45-12
Aluminum Bronze . . . . . ASTM B148 C95200 (casting)
ASTM B169 C61400 (facing)
Carbon Steel/Cast Steel . . ASTM A216 GR. WCB*
T410 Stainless Steel . . . . ASTM A217 GR. CA-15
T316 Stainless Steel . . . . ASTM A351 GR. CF8M (casting)
ASTM A240 S31600 (facing)
Monel . . . . ASTM A494 GR. 35-1
Aluminum . . ASTM B26 Alloy 713.0
5CR . . . . . ASTM A217 GR. C5
9CR . . . . . ASTM A217 GR. C12
Nickel . . . . Per customer request

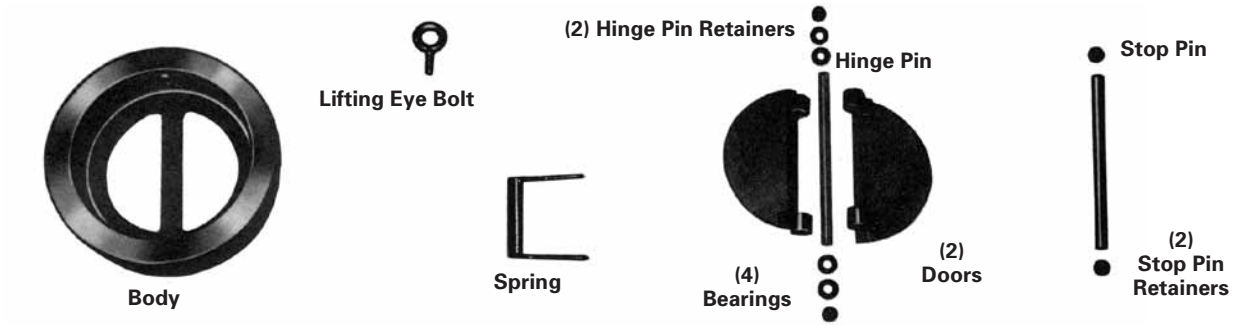
Hinge And Stop Pins, Pin Retainers (Bar Stock Parts)

T316 Stainless Steel . . . . ASTM A276 S31600
Monel . . . . . ASTM B164 Alloy 400

*** Steel to ASTM A352 GR. LCB for low temperature service is available.**

Note: For materials not listed above, use trim designation Z and specify required material.

Double Door Check Valve Components

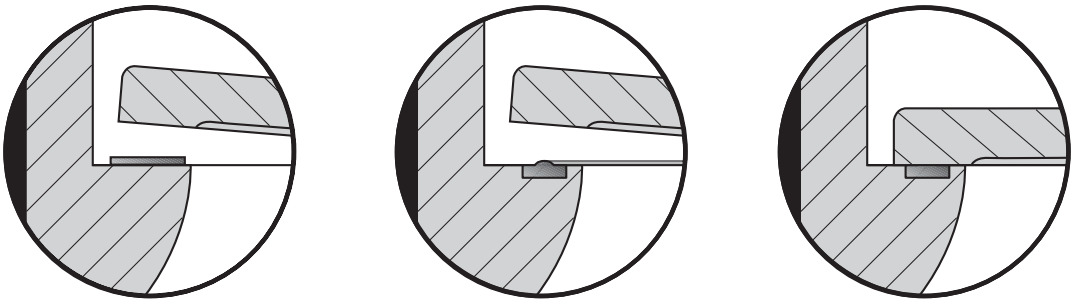


Recommended Temperature Limits for Standard Spring Materials		
Spring Material	Maximum Operating Temperatures	
	°F	°C
Stainless Steel T316	325	163
Inconel	625	329
Inconel X (Heat Treated)	1000	538
Monel	225	107

Operating Temperature Ranges For Standard Seat Materials		
Seat Material	Operating Temperature Range	
	°F	°C
Buna-N	-70 to 250	-57 to 121
Metal to Metal	-450 to 1000	-268 to 538
Viton A*	-40 to 425	-40 to 218
Neoprene	-40 to 250	-40 to 121
For pressures of 25 psi (172 kpa) or less, contact factory for soft seat recommendations.		

*A product designation of DuPont.

Cross Sectional Views Buna-N Seals



Standard Seal Open

High Pressure Seal Open for 400# Class & Higher

High Pressure Seal Closed

DDCV seals are compression molded under strict quality control standards. Every seal is tested.

Buna-N seals on high pressure series Double Door Check Valves (DDCVs) withstand elevated pressure without leaking, setting or damage. The seal is compression molded under tons of pressure into a groove in the body. Therefore, when the DDCV is shut off under high pressure the seal is forced back into the groove and protected against damage. Seals on all series DDCVs are compression molded into the bodies, not on the doors. In this manner the seal is further protected from the direct flow stream.

APCO Pressure-Temperature Ratings

Maximum Non-Shock Service Pressure (psi/kpa)																									
Temp °F / °C	Cast Iron ASTM A126 GR.B						Ductile Iron ASTM A536		Bronze ASTM B62		Carbon Steel ASTM A216 GR WCB							Stainless Steel ASTM A351 CF 8M						
	Class 125#			Class 250#			Pressure Class		Pressure Class		Pressure Class							Pressure Class						
	1-12" 25-300	14-24" 350-600	30" ≥ 750 ≥	1-12" 25-300	14-24" 350-600	30" ≥ 750 ≥	150	300	150	300	150	300	400	600	900	1500	2500	150	300	400	600	900	1500	2500
0–150 -18–66									225 1551	500 3447														
-20–100 -29–38							250 1724	640 4413			285 1965	740 5102	990 6826	1480 10204	2220 15306	3705 25545	6170 42541	275 1896	720 4964	960 6619	1440 9928	2160 14893	3600 24821	6000 41369
-20–150 -29–66	200 1379	150 1034	150 1034	500 3447	300 2068	300 2068	242 1669	620 4275			272 1875	707 4875	945 6516	1415 9756	2122 14631	3540 24407	5897 40658	257 1772	670 4619	892 6150	1340 9239	2010 13858	3347 23077	5580 38473
200 93	190 1310	135 931	115 793	460 3172	280 1931	250 1724	235 1620	600 4137	210 1448	465 3206	260 1793	675 4654	900 6205	1350 9308	2025 13962	3375 23270	5625 38783	240 1655	620 4275	825 5688	1240 8549	1860 12824	3095 21339	5160 35577
250 121	175 1207	125 862	85 586	415 2861	260 1793	200 1379	225 1551	582 4013	195 1344	425 2930	245 1689	665 4585	887 6116	1332 9184	1997 13769	3327 22939	5547 38245	227 1565	590 4068	785 5412	1180 8136	1770 12204	2945 20305	4910 33853
300 149	165 1138	110 758	50 345	375 2586	240 1655	150 1034	215 1482	565 3896	180 1241	390 2689	230 1586	655 4516	875 6033	1315 9067	1970 13583	3280 22615	5470 37714	215 1482	560 3861	745 5137	1120 7722	1680 11583	2795 19271	4660 32130
Seat Test PSI kPa	200 1379	150 1034	150 1034	500 3447	300 2068	300 2068	275 1896	720 4964	300 2068	1000 6895	315 2172	815 5619	1090 7515	1630 11238	2445 16858	4075 28096	6790 46815	305 2103	795 5481	1060 7308	1585 10928	2380 16410	3960 27303	6600 45505
Shell Test PSI kPa	300 2068	230 1586	230 1586	750 5171	450 3103	450 3103	400 2758	975 6722	450 3103	1500 10342	450 3103	1125 7757	1500 10342	2225 15341	3350 23097	5575 38438	9275 63949	425 2930	1100 7584	1450 9997	2175 14996	3250 22408	5400 37232	9000 62053

F° PSI Inch
C° kPa Millimeter

Actual flow testing for head loss characteristics. 1991, Conducted at Utah State University Water Research Laboratory, Logan, Utah

All APCO Valves including DDCVs are 100% hydrostatically pressure tested for soundness of body, door castings and tightness of seating. Each DDCV must pass a rigid, high pressure, no-leak test witnessed by a qualified inspector before it is released.

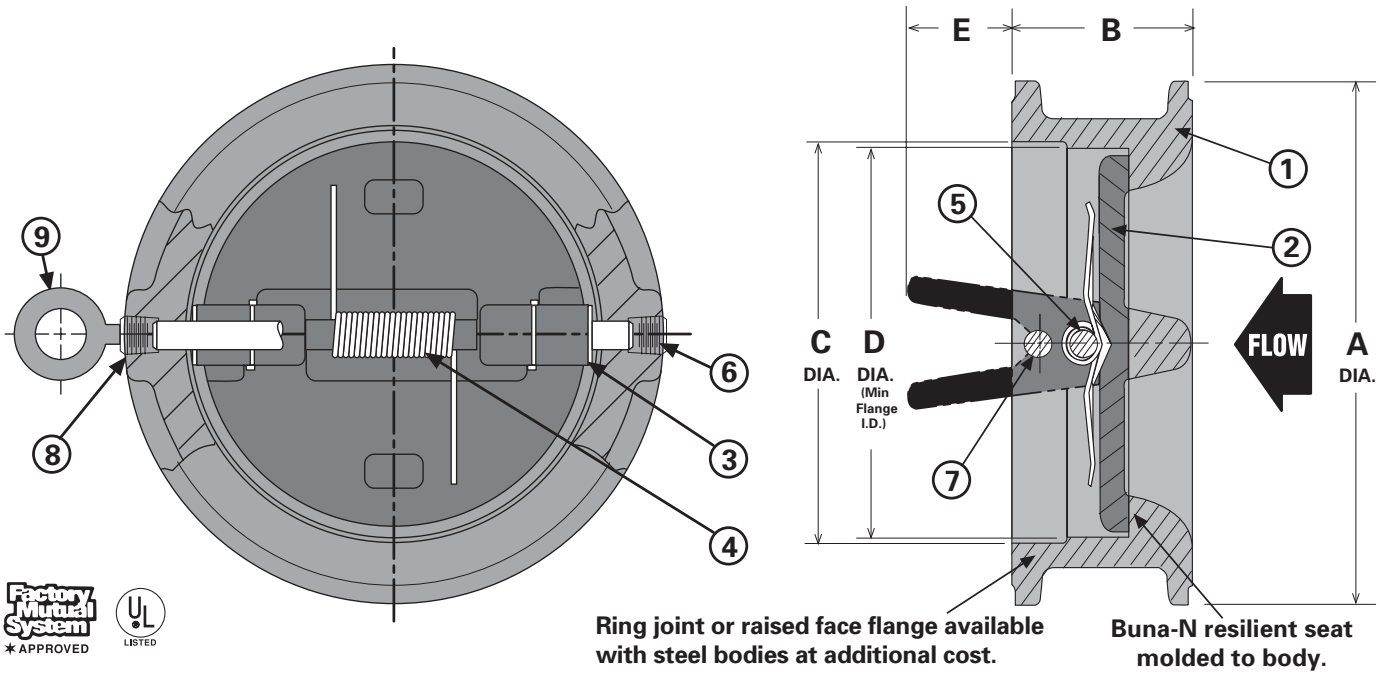
Double Door Check Valve

Pressure - Temperature Ratings (ANSI B16.5) (ANSI B16.34) for Carbon Steel ASTM A216-WCB and T316 Stainless Steel ASTM A351-CF8M

Temp	Maximum Non-Shock Service Pressure (psi/kpa)													
	150# Class		300# Class		400# Class		600# Class		900# Class		1500# Class		2500# Class	
°F/°C	Steel	S.S.	Steel	S.S.	Steel	S.S.	Steel	S.S.	Steel	S.S.	Steel	S.S.	Steel	S.S.
-20 to 100 -29 to 37.8	285 1965	275 1896	740 5102	720 4964	990 6826	960 6619	1480 10204	1440 9928	2220 15306	2160 14893	3705 25545	3600 24821	6170 42541	6000 41369
200 93.3	260 1793	240 1655	675 4654	620 4275	900 6205	825 5688	1350 9308	1240 8549	2025 13962	1860 12824	3375 23270	3095 21339	5625 38783	5160 35577
300 148.9	230 1586	215 1482	655 4516	560 3861	875 6033	745 5137	1315 9067	1120 7722	1970 13583	1680 11583	3280 22615	2795 19271	5470 37714	4660 32130
400 204.4	200 1379	195 1344	635 4378	515 3551	845 5826	685 4723	1270 8756	1030 7102	1900 13100	1540 10618	3170 21856	2570 17720	5280 36404	4280 29510
500 260	170 1172	170 1172	600 4137	480 3309	800 5516	635 4378	1200 8274	955 6584	1795 12376	1435 9894	2995 20650	2390 16478	4990 34405	3980 27441
600 315.6	140 965	140 965	550 3792	450 3103	730 5033	600 4137	1095 7550	905 6240	1640 11307	1355 9342	2735 18857	2255 15548	4560 31440	3760 25924
650 343.3	125 862	125 862	535 3689	445 3068	715 4930	590 4068	1075 7412	890 6136	1610 11101	1330 9170	2685 18512	2220 15306	4475 30854	3700 25511
700 371.1	110 758	110 758	535 3689	430 2965	710 4895	575 3964	1065 7343	865 5964	1600 11032	1295 8929	2665 18375	2160 14893	4440 30613	3600 24821
750 398.9	95 655	95 655	505 3482	425 2930	670 4619	565 3896	1010 6964	845 5826	1510 10411	1270 8756	2520 17375	2110 14548	4200 28958	3520 24270
800 426.7	80 552	80 552	410 2827	415 2861	550 3792	555 3827	825 5688	830 5723	1235 8515	1245 8584	2060 14203	2075 14307	3430 23649	3460 23856
850 454.4	65 448	65 448	270 1862	405 2792	355 2448	540 3723	535 3689	810 5585	805 5550	1215 8377	1340 9239	2030 13996	2230 15375	3320 22891
900 482.2	50 345	50 345	170 1172	395 2723	230 1586	525 3620	345 2379	790 5447	515 3551	1180 8136	860 5929	1970 13583	1430 9860	3280 22615
950 510	35 241	35 241	105 724	385 2654	140 965	515 3551	205 1413	775 5343	310 2137	1160 7998	515 3551	1930 13307	860 5929	3220 22201
1000 537.8	20 138	20 138	50 345	365 2517	70 483	485 3344	105 724	725 4999	155 1069	1090 7515	260 1793	1820 12548	430 2965	3030 20891
Hydrostatic Shell Test Pressure	450 3103	425 2930	1125 7757	1100 7584	1500 10342	1450 9997	2225 15341	2175 14996	3350 23097	3250 22408	5575 38438	5400 37232	9275 63949	9000 62053

PSI
kPa

Double Door Check Valve



Factory Mutual System ✶APPROVED

UL LISTED

Standard Materials of Construction

1	Body
	Cast Iron ASTM A 126 GR. B* or Ductile Iron
2	Door
	Al. Bronze ASTM B148 C95200** or Stainless Steel T304
3	Door Lug Bearing
	Teflon/Phenolic
4	Spring
	Stainless Steel ASTM A313 T316
5	Hinge Pin
	Stainless Steel ASTM A276 T316

6	Hinge Pin Retainer
	Steel
7	Stop Pin
	Stainless Steel ASTM A276 T316
8	Stop Pin Retainer
	Steel
9	Lifting Eye Bolt
	Steel

*** 150-300 lb. class valves have cast steel ASTM A216 WCB bodies.**

Note: Laying lengths for ductile iron and bronze bodies are same as 125 lb. and 250 lb. class valves.

**** Sizes 30" & larger have Al. bronze or stainless steel facing on the door sealing area.**

Design Advantages

APCO Double Door Check Valves (DDCVs) are excellent general purpose check valves. The Double Door Check combines compact design and heavy construction to permit low purchase price and lower cost of installation.

Installation

Wafer Style DDCVs are lightweight because they are extremely compact in laying length and have no flanges. Therefore sizes to 4" are easily installed by hand. Larger sizes come furnished with a lifting eye bolt for easier installation.

DDCVs can be installed horizontally or vertically (flow up) to conserve valuable piping space. Once installed between flanges, the DDCV has more rigidity than heavy steel walled pipe of the same length, therefore valve supports are not needed. **The valve must be installed with the hinge pin in the vertical position for horizontal flow applications.**

Operation

The DDCV is held closed by the legs of the torsion spring. Flow (head) from the pump causes the DDCV to open. Conversely, when the pump is stopped flow decay occurs and at a point near zero velocity, the force from the legs of the torsion spring instantly closes the DDCV for quick shut-off.

Resilient Seating

Standard seal material in all APCO DDCVs is Buna-N. The sealing principle is similar to that of a static O-ring, but once shut off is effected, the Buna-N is pressed flat giving a wide seating area for an effective low pressure seal. In high pressure valves (400# class and higher), the Buna-N seal is pressed into its cavity and protected from damage caused by compression and metal to metal contact that develops between the double doors and the body seat. Buna-N has been successfully used for seals and seats in valves for many years. Buna-N has excellent water, oil and gas resistance and generally can be used in temperatures -70° to 250°F (-56° to 121° C).

Dimensions - Series 9000

Size	Class	A	B	C	D	E	Wt.
2" 50	125	4" 102	2.125" 54	2.563" 65	1.875" 48	.188" 5	5 2
	150	4" 102	2.375" 60	2.563" 65	1" 25	—	6 3
	250	4.25" 108	2.125" 54	2.563" 65	1.875" 48	.188" 5	8 4
	300	4.25" 108	2.375" 60	2.563" 65	1" 25	—	8 4
2.5" 65	125	4.75" 121	2.375" 60	3.125" 79	2.375" 60	.375" 10	8 4
	150	4.75" 121	2.625" 67	3.125" 79	2" 51	.25" 6	8 4
	250	5" 127	2.375" 60	3.125" 79	2.375" 60	.375" 10	11 5
	300	5" 127	2.625" 67	3.125" 79	2" 51	.25" 6	12 5
3" 80	125	5.25" 133	2.625" 67	3.5" 89	3" 76	.5" 13	10 5
	150	5.25" 133	2.875" 73	3.5" 89	2.75" 70	.25" 6	11 5
	250	5.75" 146	2.625" 67	3.5" 89	3" 76	.5" 13	15 7
	300	5.75" 146	2.875" 73	3.5" 89	2.75" 70	.25" 6	16 7
* 4" 100	125	6.75" 171	2.625" 67	4.5" 114	4.375" 111	1.125" 29	12 5
	150	6.75" 171	2.875" 73	4.5" 114	4" 102	.875" 22	14 6
	250	7" 178	2.625" 67	4.5" 114	4.375" 111	1.125" 29	20 9
	300	7" 178	2.875" 73	4.5" 114	4" 102	.875" 22	22 10
5" 125	125-150	6.75" 171	2.625" 67	4.5" 114	4.375" 111	1.125" 29	30 14
	250-300	8.375" 213	3.25" 83	5.563" 141	5" 127	1.25" 32	33 15
* 6" 150	125	8.625" 219	3.75" 95	6.625" 168	6" 152	1.5" 38	30 14
	150	8.625" 219	3.875" 98	6.625" 168	5.875" 149	1.375" 35	32 15
	250	9.75" 248	3.75" 95	6.625" 168	6" 152	1.5" 38	40 18
	300	9.75" 248	3.875" 98	6.625" 168	5.875" 149	1.375" 35	44 20
* † 8" 200	125-150	10.875" 276	5" 127	8.75" 222	7.75" 197	1.5" 38	52 24
	250-300	12" 305	5" 127	8.75" 222	7.75" 197	1.5" 38	70 32
* † 10" 250	125	13.25" 337	5.5" 140	10.75" 273	10" 254	2.625" 67	63 29
	150	13.25" 337	5.75" 146	10.75" 273	9.75" 248	2.375" 60	100 45
	250	14.125" 359	5.5" 140	10.75" 273	10" 254	2.625" 67	110 50
	300	14.125" 359	5.75" 46	10.75" 273	9.75" 248	2.375" 60	115 52

Size	Class	A	B	C	D	E	Wt.
* † 12" 300	125-150	16" 406	7.125" 181	12.75" 324	10.875" 276	2.625" 67	150 68
	250-300	16.5" 419	7.125" 181	12.75" 324	10.875" 276	2.625" 67	220 100
14" 350	125-150	17.625" 448	7.25" 184	14" 356	13" 330	3.5" 89	220 100
	250-300	19" 483	8.75" 222	14" 356	12" 305	2" 51	440 200
16" 400	125-150	20.125" 511	7.5" 191	16" 406	15" 381	4.25" 108	275 125
	250-300	21.5" 546	9.125" 232	16" 406	14" 356	2.625" 67	550 249
18" 450	125-150	21.5" 546	8" 203	18" 457	17" 432	4.875" 124	300 136
	250-300	23.375" 594	10.375" 264	18" 457	16" 406	2.5" 64	665 302
20" 500	125	23.25" 591	8.375" 213	20" 508	18" 457	6.75" 171	325 147
	150	23.75" 603	8.625" 219	20" 508	18" 457	6.5" 165	490 222
	250	25.625" 651	11.5" 292	20" 508	17" 432	3.625" 92	450 204
	300	25.625" 651	11.5" 292	20" 508	17" 432	3.625" 92	800 363
24" 600	125-150	28.125" 714	8.75" 222	24" 610	22.625" 575	8.875" 225	700 318
	250-300	30.375" 772	12.5" 318	24" 610	21" 533	5.125" 130	1135 515
30" 750	125-150	34.625" 879	12" 305	30" 762	28.625" 727	11.125" 283	1100 499
	250-300	37.25" 946	14.5" 368	30" 762	27.375" 695	8.625" 219	1400 635
36" 900	125-150	41.125" 1045	14.5" 368	36" 914	34" 864	12.375" 314	1520 689
	250-300	43.75" 1111	18.875" 479	36" 914	33" 838	8" 203	1900 862
42" 1100	125-150	47.875" 1216	17" 432	42" 1067	40.375" 1026	15.125" 384	3000 1361
	250-300	50.625" 1286	22.375" 568	42" 1067	39" 991	9.75" 248	3500 1588
48" 1200	125-150	54.375" 1381	20.625" 524	48" 1219	46.625" 1184	16.875" 429	4500 2041
	250-300	58.625" 1489	24.75" 629	48" 1219	45.625" 1159	12.75" 324	5500 2495
54" 1400	125-150	60.875" 1546	21.25" 540	54" 1372	52.875" 1343	19.625" 498	6700 3039
60" 1500	125	67.25" 1708	25" 635	59.5" 1511	50" 1270	16" 406	7500 3402

Inch
Millimeter

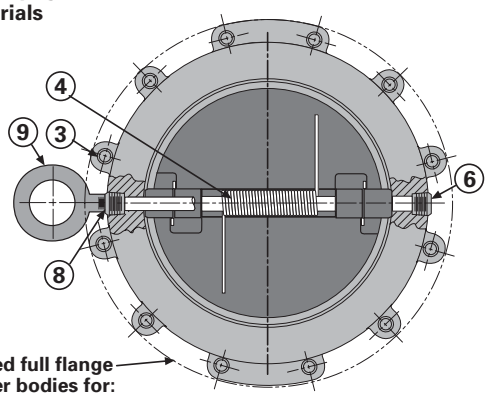
Inch lbs
Millimeter kg

*** FM - valves are factory mutual approved (125 & 250 lb.).**
† This size valve Underwriters Laboratories listed (125 lb.).

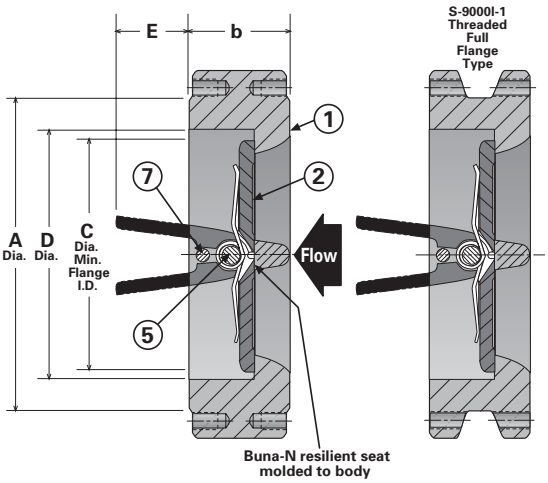
Note: Two or more springs used on sizes 14" (350mm) & larger.

Double Door Check Valve - Threaded Lug

See chart on previous page for component materials listed here.



Threaded full flange diameter bodies for:
18" - 48"(450 - 1200mm) (125 lb.)
All sizes (250 lb.)



Buna-N resilient seat molded to body

Size	125# - 150# Class										250# - 300# Class									
	A	B	C	D	E	Wt.	Threaded Lugs				A	B	C	D	E	Wt.	Threaded Lugs			
							No.	B.C.	UNC	ISO							No.	B.C.	UNC	ISO
2" / 50	4" / 102	2.125" / 54	2.063" / 52	2.563" / 65	.188" / 5	9 / 4	4	4.75" / 121	.625-11	16-2	4.25" / 108	2.125" / 54	1.938" / 49	2.563" / 65	.188" / 5	10 / 5	8	5" / 127	.625-11	16-2
2.5" / 65	4.75" / 121	2.375" / 60	2.469" / 63	3.125" / 79	.375" / 10	13 / 6	4	5.5" / 140	.625-11	16-2	5" / 127	2.375" / 60	2.344" / 60	3.125" / 79	.375" / 10	14 / 6	8	5.875" / 149	.75-10	18-2.5
3" / 80	5.25" / 133	2.625" / 67	3.063" / 78	3.5" / 89	.5" / 13	15 / 7	4	6" / 152	.625-11	16-2	5.75" / 146	2.625" / 67	2.906" / 74	3.5" / 89	.5" / 13	16 / 7	8	6.625" / 168	.75-10	18-2.5
4" / 100	6.75" / 171	2.625" / 67	4.375" / 111	4.5" / 114	1.125" / 29	20 / 9	8	7.5" / 191	.625-11	16-2	7" / 178	2.625" / 67	4.375" / 111	4.5" / 114	1.125" / 29	22 / 10	8	7.875" / 200	.75-10	18-2.5
5" / 125	7.625" / 194	3.25" / 83	5" / 127	5.563" / 141	1.25" / 32	28 / 13	8	8.5" / 216	.75-10	18-2.5	8.375" / 213	3.25" / 83	4.813" / 122	5.563" / 141	1.25" / 32	31 / 14	8	9.25" / 235	.75-10	18-2.5
6" / 150	8.625" / 219	3.75" / 95	6.063" / 154	6.625" / 168	1.5" / 38	36 / 16	8	9.5" / 241	.75-10	18-2.5	9.75" / 248	3.75" / 95	5.766" / 146	6.625" / 168	1.5" / 38	40 / 18	12	10.625" / 270	.75-10	18-2.5
8" / 200	10.875" / 276	5" / 127	7.969" / 202	8.75" / 222	1.5" / 38	68 / 31	8	11.75" / 298	.75-10	18-2.5	12" / 305	5" / 127	7.625" / 194	8.75" / 222	1.5" / 38	75 / 34	12	13" / 330	.875-9	20-2.5
10" / 250	13.25" / 337	5.5" / 140	10" / 254	10.75" / 273	2.625" / 67	101 / 46	12	14.25" / 362	.875-9	20-2.5	14.125" / 359	5.5" / 140	9.563" / 243	10.75" / 273	2.625" / 67	111 / 50	16	15.25" / 387	1-8	24-3
12" / 300	16" / 406	7.125" / 181	11.938" / 303	12.75" / 324	2.625" / 67	183 / 83	12	17" / 432	.875-9	20-2.5	16.5" / 419	7.125" / 181	11.375" / 289	12.75" / 324	2.625" / 67	201 / 91	16	17.75" / 451	1.125-7	30-3.5
14" / 350	17.625" / 448	7.25" / 184	12.5" / 318	14" / 356	3.5" / 89	301 / 137	12	18.75" / 476	1-8	24-3	19" / 483	8.75" / 222	12.5" / 318	14" / 356	2" / 51	331 / 150	20	20.25" / 514	1.125-7	30-3.5
16" / 400	20.125" / 511	7.5" / 191	15" / 381	16" / 406	4.25" / 108	393 / 178	16	21.25" / 540	1-8	24-3	21.5" / 546	9.125" / 232	14.313" / 364	16" / 406	2.625" / 67	432 / 196	20	22.5" / 572	1.25-7	30-3.5
18" / 450	21.5" / 546	8" / 203	16.875" / 429	18" / 457	4.875" / 124	490 / 222	16	22.75" / 578	1.125-7	30-3.5	23.375" / 594	10.375" / 264	16.875" / 429	18" / 457	2.5" / 64	539 / 244	24	24.75" / 629	1.25-7	30-3.5
20" / 500	23.75" / 603	8.375" / 213	18.813" / 478	20" / 508	6.75" / 171	575 / 261	20	25" / 635	1.125-7	30-3.5	25.625" / 651	11.5" / 292	17.938" / 456	20" / 508	3.625" / 92	632 / 287	24	27" / 686	1.25-7	30-3.5
24" / 600	28.125" / 714	8.75" / 222	22.625" / 575	24" / 610	8.875" / 225	745 / 338	20	29.5" / 749	1.25-7	30.3.5	30.375" / 772	12.5" / 318	21.563" / 548	24" / 610	5.125" / 130	819 / 371	24	32" / 813	1.5-6	36-4
30" / 750	34.625" / 879	12" / 305	29.25" / 743	30" / 762	11.125" / 283	1482 / 672	28	36" / 914	1.25-7	30-3.5	37.25" / 946	14.5" / 368	28.75" / 730	30" / 762	8.625" / 219	1630 / 739	28	39.25" / 997	1.75-5	42-4.5
36" / 900	41.125" / 1045	14.5" / 368	35" / 889	36" / 914	12.375" / 314	2000 / 907	32	42.75" / 1086	1.5-6	36-4	43.75" / 1111	18.75" / 476	35" / 889	36" / 914	8" / 203	2200 / 998	32	46" / 1168	2-4.5	52-5
42" / 1100	47.875" / 1216	17" / 432	41" / 1041	42" / 1067	15.125" / 384	—	36	49.5" / 1257	1.5-6	36-4	50.5" / 1283	22.375" / 568	41" / 1041	42" / 1067	9.75" / 248	—	36	52.75" / 1340	2-4.5	52-5
48" / 1200	54.375" / 1381	20.625" / 524	47" / 1194	48" / 1219	16.875" / 429	—	44	56" / 1422	1.5-6	36-4	58.5" / 1486	24.75" / 629	47" / 1194	48" / 1219	12.75" / 324	—	40	60.75" / 1543	2-4.5	52-5

Inch lbs
Millimeter kg

Threaded Lug Double Door Check Valves

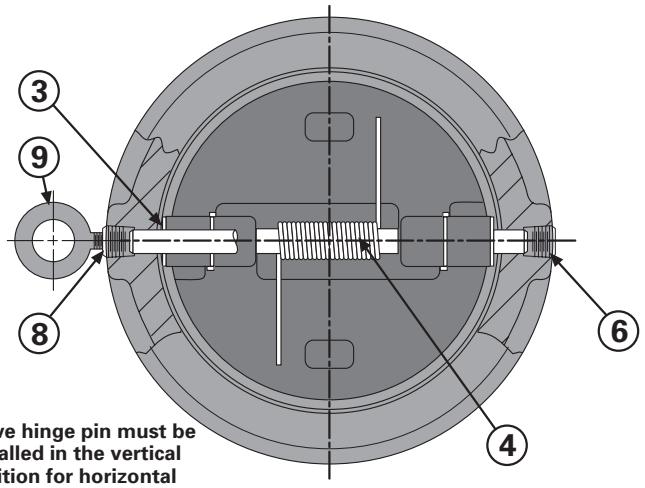
The most important feature of the Threaded Lug Double Door Check Valve (DDCV) is that it can be used as a block valve. This valve fits between flanges in the same manner the plain DDCV does, with the exception that the bolts coming through the pipe flange screw into the threaded lugs on the check valve body. In this manner, the check valve is securely fastened to the mating flange of the pipeline. With this feature, if repairs are necessary upstream of the check valve, the upstream flange can be disconnected. The repairs are then made to the pipeline or pump while the check valve remains in place acting as a block valve to the system.

The Threaded Lug DDCV minimizes maintenance to the pipeline and pumping system. Therefore, where it is essential to maintain fluid on the downstream side of the check valve, we recommend the use of the Threaded Lug DDCV.

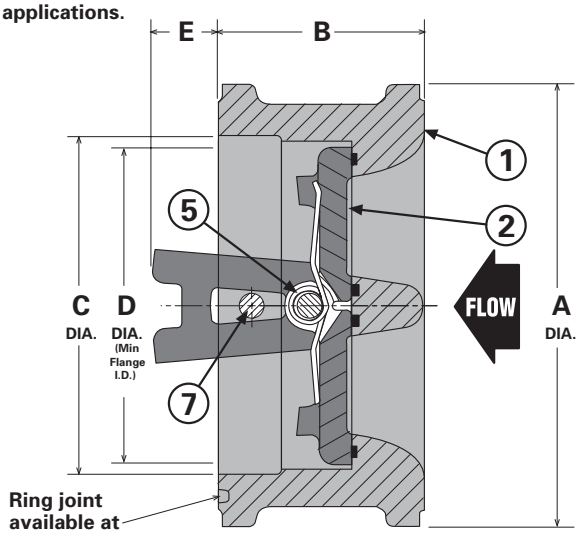
For example, mounting a Threaded Lug DDCV immediately to the discharge of the pump will allow access to the pump for repair without removal of the check valve from the line.

Double Door Check Valve - High Pressure

Series 9400



Valve hinge pin must be installed in the vertical position for horizontal flow applications.



Ring joint available at additional cost.

Buna-N resilient seat molded to body. Metal to metal seating is available upon request.

Size	Class	A	B	C	D	E	Wt.
2" 50	400-600	4.25" 108	2.375" 60	2.375" 60	1.5" 38	.125" 3	6 3
	900-1500	5.5" 140	2.75" 70	2.375" 60	1" 25	—	14 6
	2500	5.375" 137	2.75" 70	2.375" 60	1" 25	—	30 14
2.5" 65	400-600	5" 127	2.625" 67	2.875" 73	2" 51	.25" 6	9 4
	900-1500	6.375" 162	3.25" 83	2.875" 73	1" 25	—	16 7
	2500	6.5" 165	3.25" 83	2.875" 73	1" 25	—	32 15
3" 80	400-600	5.75" 146	2.875" 73	3.5" 89	3" 76	.375" 10	14 6
	900	6.5" 165	3.25" 83	3.5" 89	2.75" 70	.25" 6	28 13
	1500	6.75" 171	3.25" 83	3.5" 89	2.75" 70	.25" 6	30 14
	2500	7.625" 194	3.375" 86	3.5" 89	2.5" 64	.188" 5	46 21
4" 100	400	6.875" 175	3.125" 79	4.5" 114	4" 102	.75" 19	23 10
	600	7.5" 191	3.125" 79	4.5" 114	4" 102	.75" 19	25 11
	900	8" 203	4" 102	4.5" 114	3.75" 95	.375" 10	38 17
	1500	8.125" 206	4" 102	4.5" 114	3.75" 95	.375" 10	45 20
	2500	9.125" 232	4.125" 105	4.5" 114	3.5" 89	.313" 8	92 42
5" 125	400	8.25" 210	4.125" 105	5.563" 141	4.75" 121	.75" 19	35 16
	600	9.375" 238	4.125" 105	5.563" 141	4.75" 121	.75" 19	60 27
6" 150	400	9.625" 244	5.375" 137	6.625" 168	5.5" 140	.75" 19	68 31
	600	10.375" 264	5.375" 137	6.625" 168	5.5" 140	.75" 19	73 33
	900	11.25" 286	6.25" 159	6.625" 168	5" 127	.375" 10	120 54
	1500	11" 279	6.25" 159	6.625" 168	5" 127	.375" 10	130 59
	2500	12.375" 314	6.25" 159	6.625" 168	5" 127	.375" 10	200 91
8" 200	400	11.875" 302	6.5" 165	8.625" 219	7.5" 191	1.25" 32	145 66
	600	12.5" 318	6.5" 165	8.625" 219	7.5" 191	1.25" 32	150 68
	900	14" 356	8.125" 206	8.625" 219	7" 178	.5" 13	200 91
	1500	13.375" 340	8.125" 206	8.625" 219	7" 178	.5" 13	215 98
	2500	15.125" 384	8.125" 206	8.625" 219	7" 178	.5" 13	285 129
10" 250	400	14" 356	8.375" 213	10.75" 273	9" 229	1.375" 35	215 98
	600	15.625" 397	8.375" 213	10.75" 273	9" 229	1.375" 35	230 104
	900	17" 432	9.5" 241	10.75" 273	8" 203	.875" 22	290 132
	1500	17" 432	9.75" 248	10.75" 273	8" 203	.75" 19	310 141
	2500	18.625" 473	10" 254	10.75" 273	8" 203	.625" 16	365 166

Inch / Millimeter — Pounds / Kilograms

Materials of Construction

1	Body
	Cast Steel ASTM A216 GR. WCB
2	Door
	Stainless Steel ASTM A351 GR. CF8M[1]
3	Door Lug Bearing
	Teflon/Phenolic
4	Spring
	Stainless Steel Type T316
5	Hinge Pin
	Stainless Steel Type T316

6	Hinge Pin Retainer
	Steel
7	Stop Pin
	Stainless Steel Type T316
8	Stop Pin Retainer
	Steel
9	Lifting Eye Bolt[2]
	Steel

1-Size 14" (350mm) and larger have stainless steel ASTM A240 S31600 faced cast steel ASTM A216 GR. WCB doors.

2-Sizes 5" (125mm) and larger have a Lifting Eye Bolt.

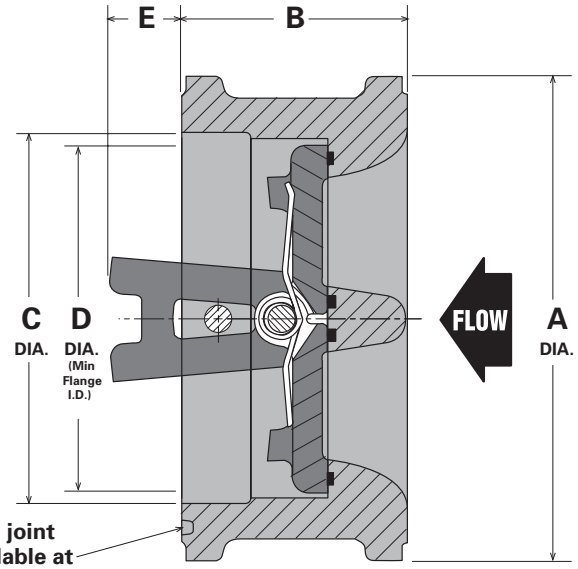
Double Door Check Valve - High Pressure

Series 9400

Size	Class	A	B	C	D	E	Wt.
12" 300	400	16.375" 416	9" 229	12.75" 324	11" 279	2.125" 54	300 136
	600	17.875" 454	9" 229	12.75" 324	11" 279	2.125" 54	320 145
	900	19.5" 495	11.5" 292	12.75" 324	10" 254	1" 25	375 170
	1500	20.375" 518	12" 305	12.75" 324	10" 254	.75" 19	395 179
	2500	21.5" 546	12" 305	12.75" 324	10" 254	.75" 19	475 215
14" 350	400	18.875" 479	10.75" 273	14" 356	12" 305	2.25" 57	480 218
	600	19.25" 489	10.75" 273	14" 356	12" 305	2.25" 57	500 227
	900	20.375" 518	14" 356	14" 356	11" 279	.75" 19	—
	1500	22.625" 575	14" 356	14" 356	11" 279	.75" 19	—
16" 400	400	21" 533	12" 305	16" 406	14" 356	2.375" 60	625 283
	600	22.125" 562	12" 305	16" 406	14" 356	2.375" 60	650 295
	900	22.5" 572	15.125" 384	16" 406	13" 330	1" 25	—
	1500	25.125" 638	15.125" 384	16" 406	13" 330	1" 25	—
18" 450	400	23.25" 591	14.25" 362	18" 457	16" 406	2.5" 64	800 363
	600	24" 610	14.25" 362	18" 457	16" 406	2.5" 64	850 386
	900	25" 635	17.75" 451	18" 457	15" 381	1" 25	—
	1500	27.625" 702	18.438" 468	18" 457	15" 381	.75" 19	—
20" 500	400	25.375" 645	14.5" 368	20" 508	17" 432	3.375" 86	950 431
	600	26.75" 679	14.5" 368	20" 508	17" 432	3.375" 86	1000 454
	900	27.375" 695	17.75" 451	20" 508	16" 406	2" 51	—
	1500	29.625" 752	21" 533	20" 508	15" 381	.625" 16	—
24" 600	400	30.125" 765	15.5" 394	24" 610	21" 533	4.625" 117	1300 590
	600	31" 787	17.25" 438	24" 610	20" 508	3.875" 98	1400 635
	900	32.875" 835	19.5" 495	24" 610	19" 483	2.875" 73	—
	1500	35.875" 911	19.5" 495	24" 610	19" 483	2.875" 73	—
30" 750	400	37.125" 943	18.125" 460	30" 762	27" 686	6.625" 168	—
	600	38.125" 968	19.875" 505	30" 762	26" 660	5.375" 137	—
36" 900	400	43.875" 1114	25" 635	36" 914	32" 813	6.625" 168	—
	600	44.375" 1127	25" 635	36" 914	32" 813	6.625" 168	—
42" 1100	400	50.125" 1273	27.813" 706	42" 1067	38" 965	8.5" 216	—
	600	50.875" 1292	27.813" 706	42" 1067	38" 965	8.5" 216	—

Inch
Millimeter

Pounds
Kilograms



Ring joint available at additional cost.

Buna-N resilient seat molded to body.
Metal to metal seating is available upon request.

Equivalent Pipe Length Chart

Size	2" 50	2.5" 65	3" 80	4" 100	5" 125	6" 150	* 8" 200	10" 250	12" 300	* 14" 350	16" 400	18" 450	20" 500	24" 600	30" 750	36" 900	42" 1100	48" 1200	54" 1400	60" 1500
C_v GPM	88	139	223	408	669	993	1777	3882	4161	5119	6830	8777	10979	16104	25217	35744	49483	64000	81041	100205
C_v LPM	333	526	844	1544	2532	3759	6727	14695	15751	19378	25854	33225	41560	60960	95457	135306	187314	242266	306774	379317

*** = Certified Flow Tested** **(CV = Q at 1 psi (7 kpa) Head Loss) for water at 60° F (16° C).**

Inch
Millimeter

APCO certified flow test, conducted at Utah State University Water Research Laboratory, Report #299.

Note: When comparing similar competitors published data, only use certified flow test data.

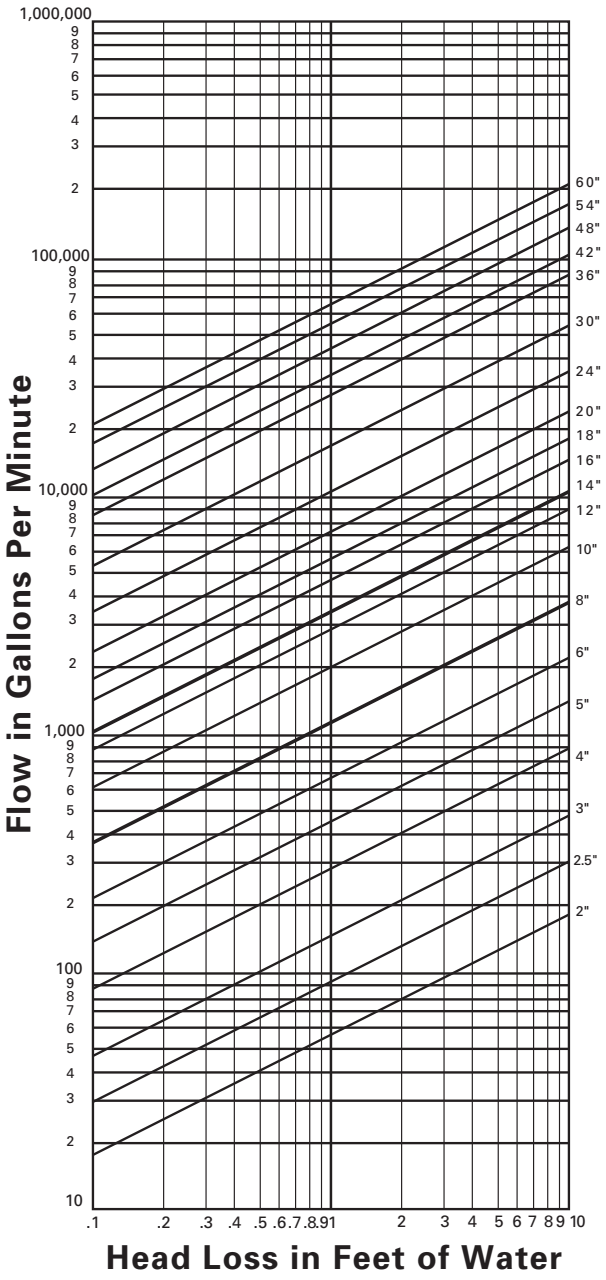
Double Door Check Valves

Water Service Head Loss Curves

Certified Flow Tested (1991)

Figures shown are based on certified flow test conducted at Utah State University, Water Research Laboratory, Report No. 299. Valves sizes 8" & 14" (200 & 350mm) Actual field conditions may vary from these curves.

Note: When comparing similar competitors published data, only use certified flow data.



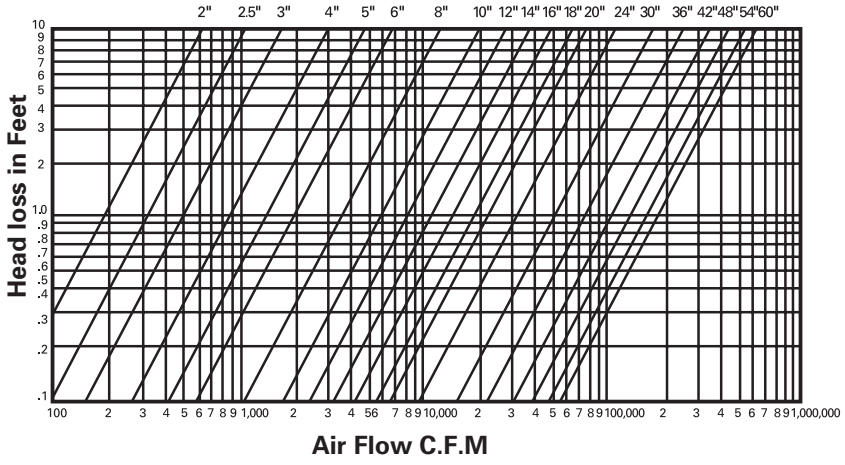
Air Service Head Loss Curves

There are two main reasons why Double Door Check Valves (DDCVs) are commonly specified for use on air blowers in sewage treatment plants and other blower applications.

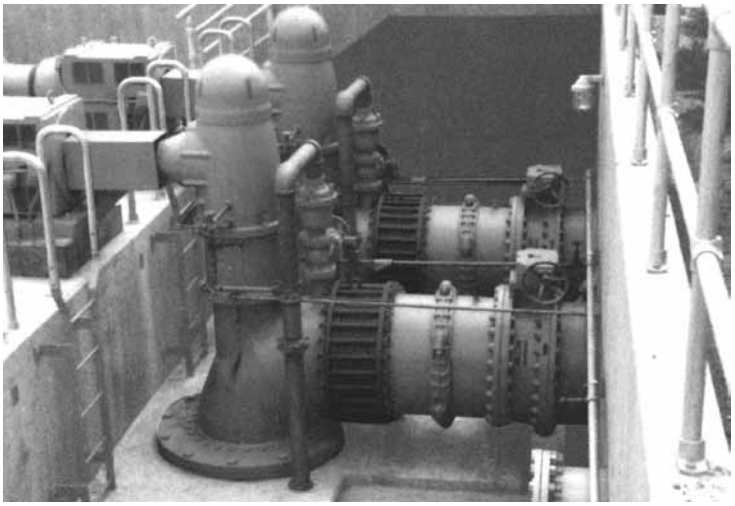
1. DDCVs are low in cost as compared to other check valves.

2. DDCVs have a low head loss.

Additional reasons are lightweight, short length and low installation cost.



Specifications



Typical Double Door Check Valve Installation
Los Angeles County Sanitary District - Los Coyotes Plant
2-30" (750mm) Double Door Check Valves

The Double Door Check Valve shall be compact wafer design to fit between ANSI flanges.

The check valve doors shall be spring loaded, normally closed, by means of one or more heavy duty stainless steel torsion springs. Flow from the pump shall cause the doors to open and upon pump shut down, the torsion spring will shut the doors before reverse flow starts. This occurs at a point of zero velocity for quick closure.

Seating shall be resilient and water tight. The sealing element shall be Buna-N molded to the body.

Valves 5" (125mm) and larger shall be fitted with a lifting eye bolt for installation purposes.

All materials of construction must be certified in writing to ASTM specifications as follows:

Body	Select one	Cast Iron ASTM A126 GR.B Cast Steel ASTM A216 WCB Ductile Iron ASTM A536	Other materials available
Doors	Select one	Al. Bronze ASTM B148 C95200 Cast Steel ASTM A216 WCB Ductile Iron ASTM A536 Stainless Steel T316, T304, T410	
Sealing element		Buna-N	
Torsion spring		T316 Stainless Steel	
Hinge shaft		T316 Stainless Steel	
Stop shaft		T316 Stainless Steel	
Exterior paint		Universal Metal Primer	

Double Door Check Valves shall be APCO series 9000-9000L-9400.

Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:
Web Site: www.dezurik.com E-Mail: info@dezurik.com

250 Riverside Ave. N. Sartell, Minnesota 56377 • Phone: 320-259-2000 • Fax: 320-259-2227

DeZURIK, Inc. reserves the right to incorporate our latest design and material changes without notice or obligation. Design features, materials of construction and dimensional data, as described in this bulletin, are provided for your information only and should not be relied upon unless confirmed in writing by DeZURIK, Inc. Certified drawings are available upon request.

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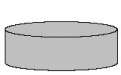
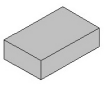
Appendix L: Tank Mixer Passive

Tideflex® Mixing System (TMS) for Water Storage Tanks & Reservoirs Design Data Form


Circular


Rectangular

Standpipe

Elevated

I. GENERAL INFORMATION

Reservoir/Tank Name:	UTMB EST	☐ Advertises On:	☐ Bids On:
Project Location:	Galveston, TX		

Water Utility/Owner Name:	City of Galveston		
Owner Contact:			
Email:			
Address:			
City:	Galveston	State:	TX
Zip:		Country:	
Phone:		Fax:	

Consulting Engineering Firm:	Kimley-Horn and Associates		
Engineer Contact:	Victoria Baltazar		
Email:	victoria.baltazar@kimley-horn.com		
Address:	11700 Katy Fwy, Suite 800		
City:	Houston	State:	TX
Zip:	77079	Country:	USA
Phone:	346-345-4878	Fax:	

II. SYSTEM INFORMATION

INSTALLATION:
☐ New Tank
■ Existing Tank

SCADA:
Tank on SCADA?
■ Yes ☐ No

WATER SOURCE:
■ Surface Water ☐ Reclaimed Water
☐ Ground Water ☐

OPERATION:
■ Distribution System Reservoir
☐ Clearwell
☐ Combination

MODE:
☐ Fill-then-draw
■ Simultaneous Fill and Draw

PRIMARY DISINFECTION:
☐ Chlorine ☐ UV ☐ Chlorine Dioxide
■ Chloramine ☐ Ozone ☐ None
☐

HIGH WATER LEVEL SHUTOFF:
■ By Altitude Valve ☐ None, Floats on System
☐ By Pressure Switch ☐

SECONDARY DISINFECTION:
■ Chlorine ☐ Chloramine ☐ None
☐ Chlorine Dioxide ☐

III. RESERVOIR / TANK DATA *(Provide tank drawings if available. See nomenclature on page 4.)*

TYPE OF RESERVOIR / TANK:		Tank Manufacturer or Basis of Design:
☐ Circular Reservoir ☐ Irregular Shape ☐ Rectangular Reservoir		☐ At Grade ☐ Semi-buried ☐ Buried
☐ Standpipe		
■ Elevated Tank	■ Dry Riser	■ Sphere/Spheroid ☐ Composite ☐ Hydropillar ☐
	☐ Wet Riser	Wet Riser Diameter ☐ ft ☐ in ☐ m

TANK DETAILS: *(Provide tank drawings if available.* ***See nomenclature on page 4.)***

VOLUME:	1.0	■ MG	Gallons	m^3	Megaliters

Circular Reservoir / Standpipe		**Elevated Tank**		**Rectangular Reservoir**	
	ft m		■ ft m		ft m
Tank Diameter		Bowl Diameter	76	Length x Width	x
Depth to Maximum Operating Level		Head Range	35	Depth to Maximum Operating Level	
Depth to Overflow		Height from Foundation to Overflow	135	Depth to Overflow	
		Height from Foundation to Maximum Operating Level	124	Number of Cells	
Bottom Elevation		Foundation Elevation	10.0	Bottom Elevation	

TANK MATERIAL: *(Select multiple if alternates for new tank.)*

■ Welded Steel	Bolted Steel (Concrete Floor)	Bolted Steel (Steel Floor)	Riveted Steel
Prestressed Concrete	Post-tensioned Concrete	Cast-in-place Concrete	
Composite (Elevated)	Earthen Lined		

TYPE OF ROOF / COVER:

■ Fixed Roof → Internal Roof Supports? Yes No		Floating Cover	None, Open Reservoir

IV. INLET / OUTLET PIPING *(For new tanks that operate in fill-then-draw and for existing tanks that have a common inlet/outlet pipe, complete the "Inlet" pipe data. The TMS separates inlet/outlet inside the tank.)*

Common Inlet/Outlet Pipe ■ Separate Inlet and Outlet Pipes

Inlet Diameter	16	■ in mm	Material: Steel	Penetration: ■ Bottom Sidewall Top	
Outlet Diameter	16	■ in mm	Material: Steel	Penetration: ■ Bottom Sidewall	
	Outlet have Silt Stop? Yes ■ No → Fixed Pipe Extension Removable				
	Does tank have a dedicated drain pipe? ■ Yes No				

V. HYDRAULIC DATA

Minimum **Fill** Rate:		■ gpm lps	■ Pumped Gravity
Maximum **Fill** Rate:			
Maximum **Draw** Rate: Peak Demand + Fire Flow (If Applicable)		■ gpm lps	Pumped ■ Gravity

VI. TANK FLUCTUATION / TURNOVER DATA *(With one of the methods below, provide data on the typical, or expected, daily fluctuation of tank levels in summer and winter, if different.* ****See nomenclature, page 4)***

	Method 1				***Method 2***	***Method 3***	
	Maximum Operating Level*		Minimum Operating Level*		**%** (Percent)	Volume Exchange	
Summer		ft		ft			Gallons/Day
Winter		m		m			Liters/Day

VII. REFROFIT INFORMATION

Year Tank Constructed:	1958
Date of Last Inspection:	
Date of Last Rehab/Repaint:	2013
Next Scheduled Rehab:	2024
Internal Baffles?	☐ Yes ☐ No
Ice Formation?	☐ Yes ☐ No
Water Temperature Range	Minimum
☐ °F ☐ °C	Maximum
Size of Largest Roof Hatch	24 ■ Dia. ☐ Sq.
Size of Largest Shell Hatch	☐ Dia. ☐ Sq.
Rechlorination/recirculation sytems installed?	☐ Yes ■ No
Are sampling taps installed?	☐ Yes ☐ No
Samples been taken at different locations/depths inside the tank?	☐ Yes ☐ No
Has a tracer study, CFD, or scale model been done?	☐ Yes ■ No

VIII. WATER QUALITY ISSUES

Identify Water Quality Issues
■ Loss of Residual
☐ Disinfection By Products > ☐ TTHM ☐ HAA5
☐ Coliform Bacteria
☐ Nitrification
☐ Elevated Heterotrophic Plate Count (HPC)
☐ Biofilms
☐ Taste and Odor
☐ Increased pH
☐ Color
☐ Turbidity
☐

Identify Known/Suspected Causes:
■ Poor Mixing
☐ Short-circuiting
■ Poor Turnover / Tank Fluctuation
☐ Long Detention Time
■ Thermal Stratification
☐ High Levels of Organics
☐

IX. OVERFLOW PIPE PROTECTION

Check method used to prevent birds, rodents, cold drafts, etc., from entering tank through overflow pipes.

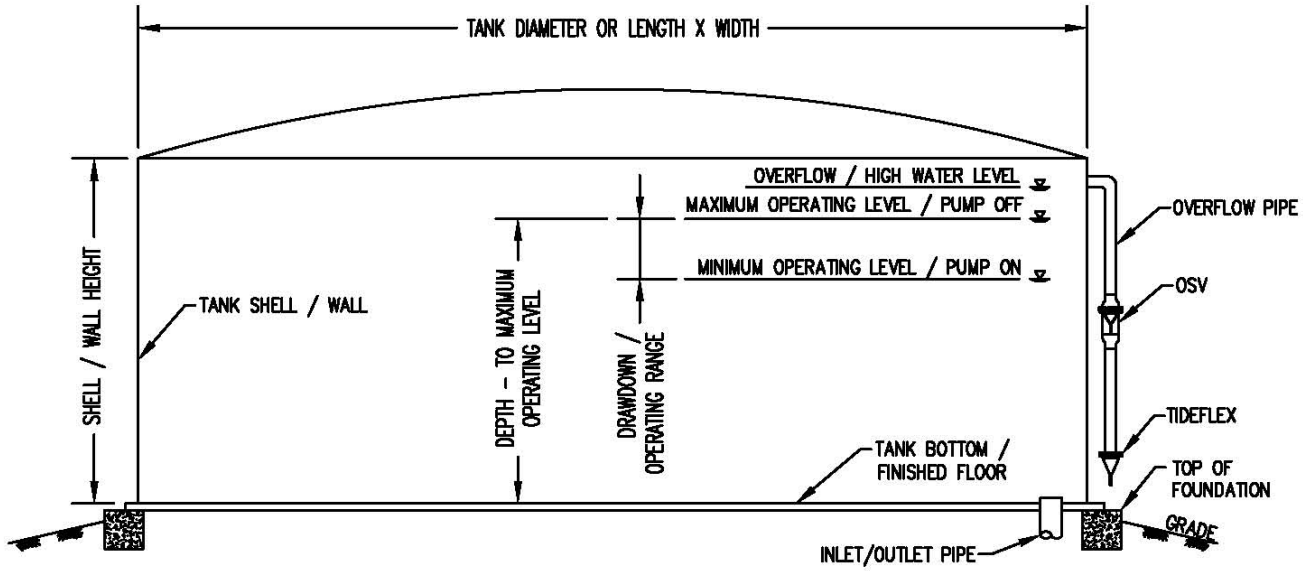
Overflow Pipe Size:	10	■ in	☐ mm

☐ **Dechlorinating Overflow Security Assembly (DOSA)** ☐ **Tideflex Valve** ☐ **Overflow Security Valve (OSV)** ☐ **Screen** ☐ **Flap Valve**

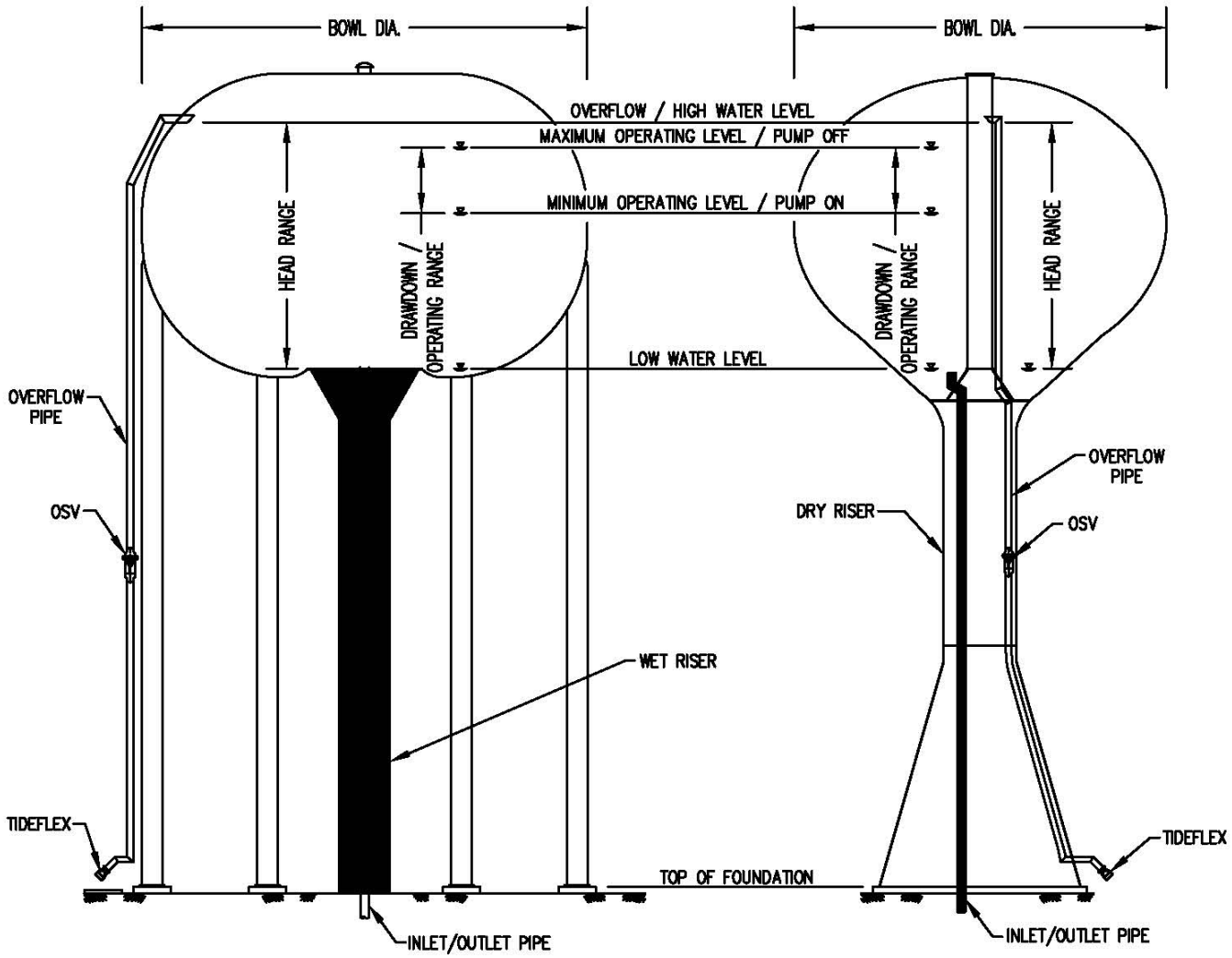
X. COMMENTS

PLEASE E-MAIL OR MAIL COPIES OF TANK DRAWINGS AND INSPECTION REPORTS/PHOTOS TO:

XI. TANK NOMENCLATURE



CIRCULAR AND RECTANGULAR RESERVOIRS AND STANDPIPES



WET RISER ELEVATED TANK

DRY RISER ELEVATED TANK

Appendix M: Tank Mixer Active

CertiSafe Mixer

CERTISAFE™
by Kasco

POTABLE WATER TANK MIXERS

CertiSafe™ Active Tank Mixers blend drinking water in tanks and reservoirs quickly and efficiently. These powerful mixing systems create an environment homogeneous in chemical concentration and temperature, improving water quality from tank to tap.

There's Sort of Safe, or There's CertiSafe.

ETL LISTED c US Intertek

NSF Certified to NSF/ANSI/CAN 61 & 372

Contact us today to learn more | 715.262.4488 | kascomarine.com/certisafe

CERTISAFE™ TANK MIXERS

A NEW MOVEMENT IN WATER

WATER QUALITY CHALLENGES

When drinking water is not mixed quickly, evenly, and continuously, it can fall out of EPA compliance, putting the health and safety of your community in danger. Common problems include:

- Thermal and chemical stratification
- Residual loss
- Biofilm buildup
- Nitrification
- Disinfection by-products
- Development of ice caps
- Sediment accumulation

CERTISAFE IS THE SOLUTION

By creating strong, consistent circulation, CertiSafe™ Tank Mixers quickly and evenly move water while eliminating common water quality problems. Available in several HP sizes, multiple mounting orientations, and various control panels, there is a CertiSafe Mixing solution for nearly every size and style of tank. See back page for mounting option and control panel information.

HP

1/2, 3/4, 1, & 2HP Available

120V, 208-240V, & Solar-Powered Options

3-Year Warranty
Optional 5-year Extended Warranty

ETL Listed to CSA and UL Standards

NSF/ANSI/CAN 61 & 372 Certified

FASTEST BLEND TIMES

Complete blending in 30 mins - 4 hrs.

LONGEST LASTING MOTORS

Food-grade mineral oil keeps motors cooler so they last longer.

ENGINEERED TO PERFORM

Each HP uses a specific prop to maximize performance.

DURABLE & REBUILDABLE

Units are rebuildable and repairable, keeping costs to a minimum.

CERTISAFE™ SPECIFICATIONS

TANK SIZE	SUPPLY / VOLTAGE	PHASE / HZ	UNIT SIZE (HP)	MIXER MODEL	CABLE LENGTH (FT)	CABLE GAUGE	AMPS	LOCK ROTOR AMPS	THRUST (LBS)
Up to 1MG	120	1 / 60HZ	1/2	2400C61	50	16	5.7	12	31
					75	14			
					100	14			
					150	**12**			
					200	**12**			
Up to 2.5MG	120	1 / 60HZ	3/4	3400C61	50	16	7	18	36
					75	14			
					100	14			
					150	**12**			
					200	**12**			
	208-240	1 / 60HZ	3/4	3400HC61	50	14	3.5	9	36
					75	14			
					100	14			
					150	**12**			
					200	**12**			
Up to 5MG	120	1 / 60HZ	1	4400C61	50	14	9.1	40	44
					75	14			
					100	**12**			
					150	**10**			
					200	**10**			
	208-240	1 / 60HZ	1	4400HC61	50	14	4.5	20	44
					75	14			
					100	14			
					150	**12**			
					200	**12**			
5MG & Over	208-240	1 / 60HZ	2	8400C61	50	14	9	40	56
					75	14			
					100	**12**			
					150	**12**			
					200	**12**			

Product Notes:

1. Cable gauges in bold indicate quick disconnect included on power cable.
2. Mounting option and control panel sold separately. See next page for details.

CONTROL & MONITOR

Monitor your CertiSafe™ Mixer with various control panels that feature H-O-A control, indicator LED, and SCADA I/O for remote operation.

CS-100 / CS-200

CS-150 / CS-250

MOUNTS

Several mounting options to fit your tank, tower, or reservoir needs.

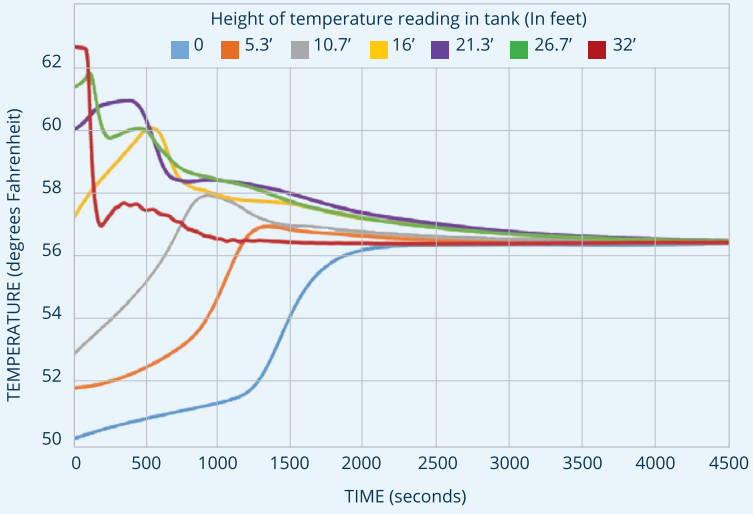
Floor Mount

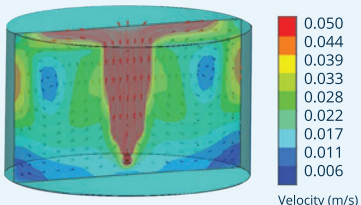
Pipe Mount

Suspended Mount

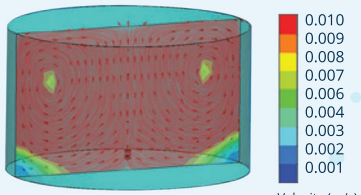
MIXING CAPABILITIES

Computational fluid dynamics (CFD) and test results using a 3/4HP CertiSafe unit to mix a .5-million-gallon tank show complete mixing in under an hour.





Velocity representation



CFD indicating tank can be thoroughly mixed over time

KASCO KNOWS WATER

For more than 50 years, Kasco has developed and deployed water circulators that run reliably in the toughest conditions. The CertiSafe™ Tank Mixer is built on this foundational platform and continues the Kasco tradition of innovation, performance, and excellence in the water quality industry.

CERTISAFE™ by Kasco

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Mounting System

CertiSafe™ SUSPENDED MOUNT

OVERVIEW

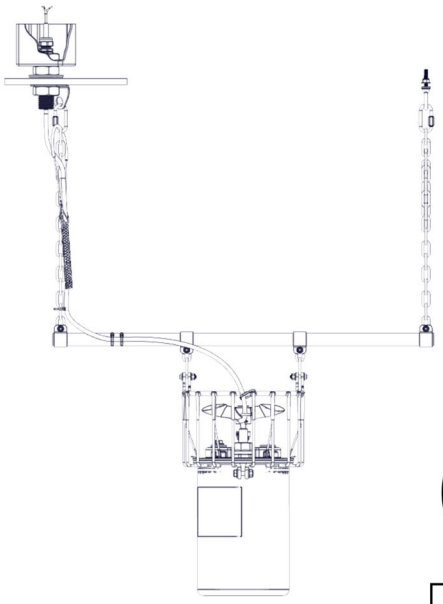
- Suspended mounts are vertically oriented and place the mixer at a chosen depth within the water column.
- Designed for elevated or standpipe tanks.
- Easy installation in full or empty tank.

INCLUDED

- Stainless stretcher bar(s) with hardware
- 316 stainless chains
- Stainless tank penetration for power cord
- Stainless tank penetration hardware to suspend cable support and chains

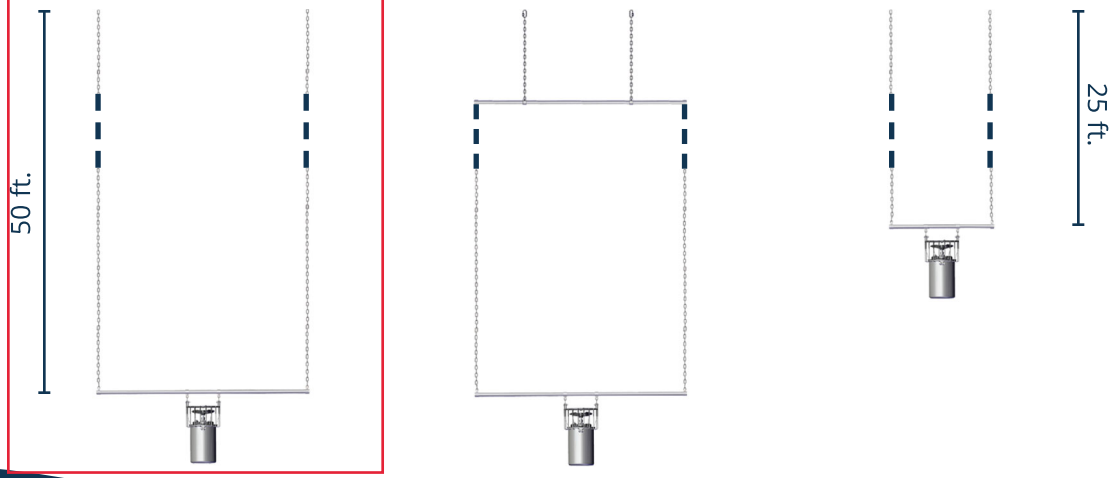
REQUIRED

- Electrical service to exterior junction box



Certified to NSF/ANSI/CAN 61 & 372

	SM-100	SM-100 + ASM-100 accessory	SM-50
Recommended unit size	2400C61 3400C61 4400C61	2400C61 3400C61 4400C61	2400C61 3400C61
Placement within the tank	Positions the mixer between 25 ft. and 50 ft. deep	Positions the mixer between 25 ft. and 50 ft. deep and moves the tank roof anchor points closer together	Positions the mixer at a depth of 25 ft. or less
Chain length	2 x 50 ft.	2 x 50 ft.	2 x 25 ft.
Stretcher bar(s)	1 x 60 in.	2 x 60 in.	1 x 30 in.



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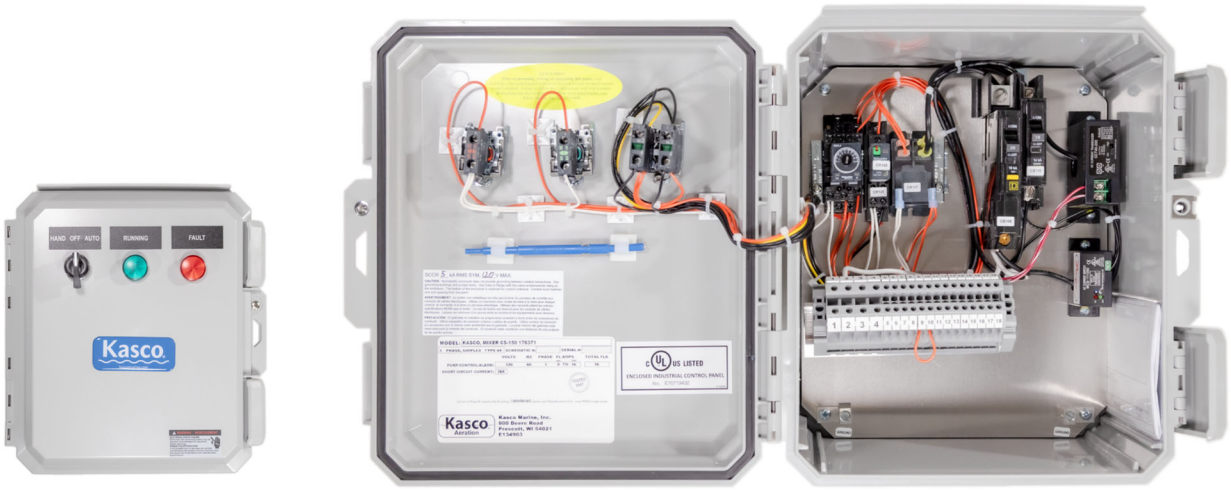
CertiSafe Panel

CertiSafe™ ADVANCED CONTROL PANEL



CS-150
For use with mixer models 2400C61, 3400C61 & 4400C61

The model CS-150 is a 120Vac, 60hz, single phase UL listed control panel engineered to operate Kasco C61 CertiSafeTM tank mixers. Designed for easy installation and operation with included GFCI circuit breaker, H-O-A control switch, indicator LEDs, Low water inhibit, and SCADA I/O for remote operation and monitoring.

REQUIRED

- 20amp feed breaker required and disconnect switch if required (supplied by others)
- Auxiliary interlock input: if utilized, the terminal jumper is replaced with a dry contact relay closure
- Remote SCADA start/stop input requires a dry contact relay closure

OPTIONAL

- 316 Stainless steel enclosure (non-stocked, built per order)

c UL US LISTED

INCLUDED

- 20amp, single pole, GFCI 6ma trip circuit breaker
- Motor contactor: 1hp, 120Vac motor load rated
- Green LED running pilot light
- Red LED Fault pilot light
- H-O-A switch (Hand-Off-Auto)
  - Hand mode operates the mixer continuously (local control)
  - Auto mode operates the mixer from remote SCADA input
- Interface for remote SCADA mixer start/stop control signal (H-O-A Auto mode)
- Low water inhibit: Inhibit mixer operation if tank level drops below operating level
- Low water inhibit sensor adjustment tool
- 4-20ma motor current output (to SCADA) for monitoring motor status and fault condition
- Dry contacts (to SCADA) for: H-O-A in Hand, H-O-A in Auto, Mixer Running, & Mixer Fault
- Auxiliary interlock input for local low tank level inhibit
- UL508A listed control panel for US and Canada
- UL type rated 4X/3R nonmetallic enclosure with pad lockable latch, and integral mounting feet.
- Detailed wiring schematic with field terminal identification.

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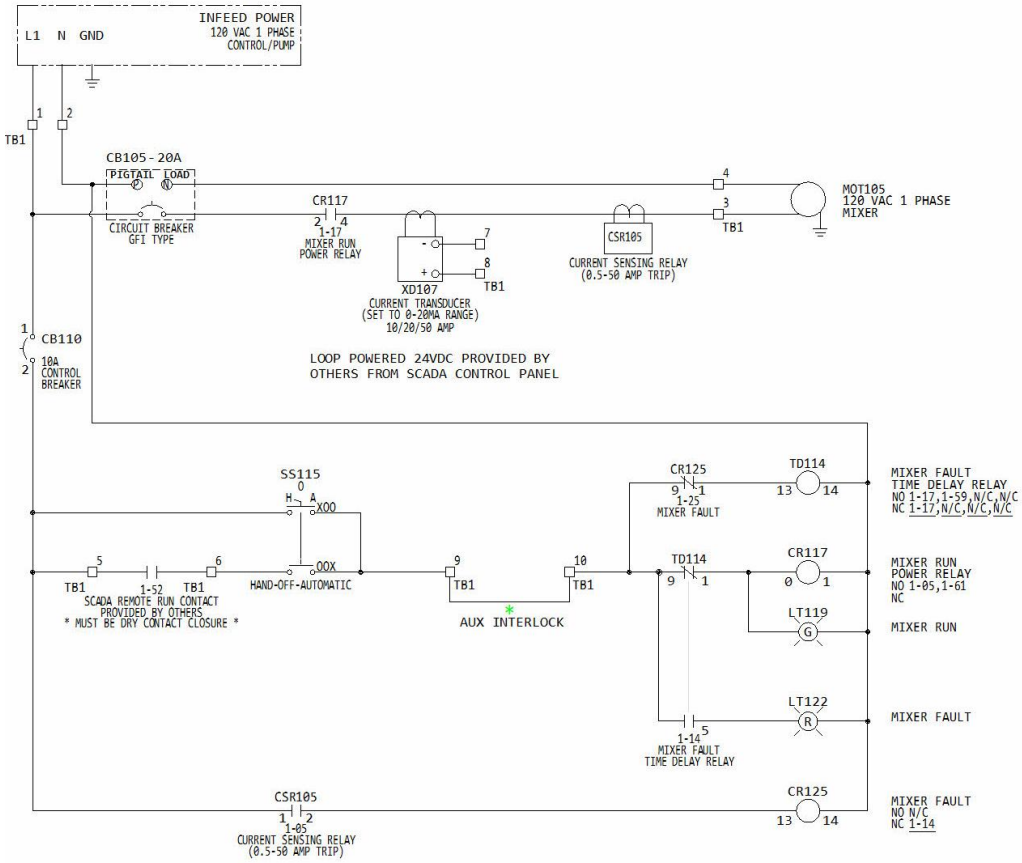
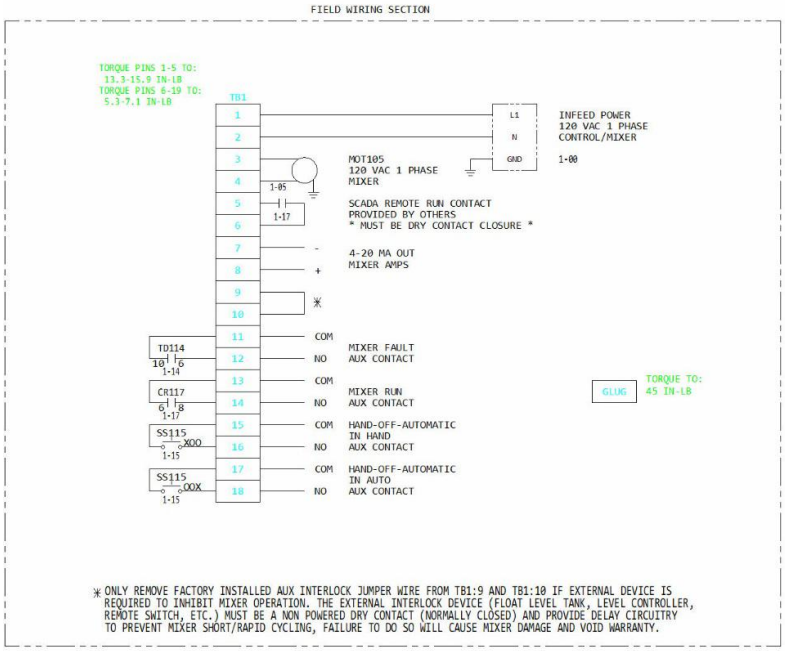
CertiSafe™ ADVANCED CONTROL PANEL

CS-150 Schematic





CertiSafe™ ADVANCED CONTROL PANEL

CS-150 / CS-250 Enclosure Dimensions