CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

For

Lift Station 13, ~~18~~, ~~30~~, 51, ~~53~~, & ~~55~~ Improvements

To Serve

City of Galveston

GALVESTON, TEXAS

JOB NO. COG-210
CONTRACT NO. 1

City of Galveston
Galveston, Texas

April 2021

STATE OF TEXAS
BRIAN K. ZOTZKY
124808
LICENSED PROFESSIONAL ENGINEER
04/05/2021

TEXAS

REGISTERED ENGINEERING FIRM
F-16194

ARCENEAUX WILSON & COLE LLC
Engineers * Surveyors * Planners
PORT ARTHUR, TEXAS

LIFT STATION 13, ~~18, 30~~, 51, ~~53~~, & ~~55~~ IMPROVEMENTS

CITY OF GALVESTON
TEXAS
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City of Galveston

REQUEST FOR PROPOSAL

Proposal Reference Number: 26-13

Project Title: Lift Stations 13 and 51 Improvements

Proposal Closing Date: 10:00 A.M.(CST), Tuesday
April 28, 2026

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

KEY EVENTS SCHEDULE

PROJECT NAME:	Lift Stations 13 and 51 Improvements
ISSUANCE OF RFP	**March 4, 2026**
PRE-BID: NON-MANDATORY CONFERENCE	**9:00. AM., (CST); Friday March 20, 2026** Location: City of Galveston Public Works Bldg. 3015 Market Street – Training Room Galveston, Texas
DEADLINE FOR QUESTIONS:	**2:00PM (CST); Wednesday April 1, 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 QUESTION(S) HERE
ADDENDA CHECKLIST: **(IF APPLICABLE)**	CHECK HERE FOR ADDENDUMS
SUBMITTAL DEADLINE:	**10:00. AM., (CST); Tuesday April 28, 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 26-13 (this "**RFP**"), from qualified vendors to provide Lift Stations (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: Lift Stations 13 and 51 Improvements

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

Project duration to final completion: 720 calendar days.

Project budget: $ 1,500,000.00

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 $1,000.00 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:	**26-13**		
Project Title:	**Lift Stations 13 and 51 Improvements**		
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)

BASE BID ITEMS

MISCELLANEOUS ITEMS

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total Amount
1	Mobilization	LS	1	$_____	$_____
2	Traffic Control including, Signs, Channelizing Devices and Barricades, Complete in Place.	LS	1	$_____	$_____
3	Bypass Pumping, Complete in Place.	EA	6	$_____	$_____
4	Tree Protection, Complete in Place.	EA	5	$_____	$_____
Subtotal Miscellaneous Items, Bid Items 1-4				$_____	

LIFT STATION 13 ITEMS

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total Amount
5	Wet Well Rehabilitation, including but not limited to new access hatches, cleaning, grouting, and Spectrashield lining, Complete in Place.	LS	1	$_____	$_____
6	Remove & Replace Lift Station Piping, including discharge piping, header piping, including all necessary bends, fittings, valves, tie in to existing force main, and appurtenances, Complete in Place.	LS	1	$_____	$_____
7	Remove & Replace Lift Station Pumps, Complete in Place.	EA	2	$_____	$_____
8	Electrical Improvements as shown on Sheets 47-50, Complete in Place.	LS	1	$_____	$_____
Subtotal Lift Station 13 Items, Bid Items 5-8				$_____	

Initials _____

LIFT STATION 18 ITEMS

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total Amount
9	Valve Vault Abandonment, Complete in Place.	LS	1	$_____	$_____
10	Wet Well Rehabilitation, including but not limited to new access hatches, cleaning, grouting, and Spectrashield lining, Complete in Place.	LS	1	$_____	$_____
11	Remove & Replace Lift Station Piping, including discharge piping, header piping, including all necessa valves, tie in to exist appurtenances, Com			$_____	$_____
12	Remove & Replace Lift Station Pumps, Complete in Place.	EA	2	$_____	$_____
13	Site Concrete, including site paving and retaining wall, Complete in Place.	SY	210	$_____	$_____
14	Site Fencing & Gates, Complete in Place.	LF	114	$_____	$_____
15	Electrical Platform, Complete in Place.	LS	1	$_____	$_____
16	Electrical Improvements as shown on Sheets 51-54, Complete in Place.	LS	1	$_____	$_____
Subtotal Lift Station 18 Items, Bid Items 9-16				$_____	

NOT IN THIS CONTRACT

Initials _____

LIFT STATION 30 ITEMS

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total Amount
17	Valve Vault Abandonment, Complete in Place.	LS	1	$_____	$_____
18	Wet Well Rehabilitation, including but not limited to new access hatches, cleaning, grouting, and Spectrashield lining, Complete in Place.	LS	1	$_____	$_____
19	Remove & Replace Lift Station Piping, including discharge piping, header piping including all necessa valves, tie in to existi appurtenances, Com			$_____	$_____
20	Remove & Replace Lift Station Pumps, Complete in Place.	EA	3	$_____	$_____
21	Site Concrete, including site paving and wetwell top extension. Complete in Place.	SY	116	$_____	$_____
22	Site Fencing & Gates, Complete in Place.	LF	173	$_____	$_____
23	Electrical Improvements as shown on Sheets 55-58, Complete in Place.	LS	1	$_____	$_____
Subtotal Lift Station 30 Items, Bid Items 17-23				$_____	

NOT IN THIS CONTRACT

Initials _____

LIFT STATION 51 ITEMS

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total Amount
24	Valve Vault Abandonment, Complete in Place.	LS	1	$_____	$_____
25	Wet Well Rehabilitation, including but not limited to new access hatches, cleaning, grouting, and Spectrashield lining, Complete in Place.	LS	1	$_____	$_____
26	Remove & Replace Lift Station Piping, including discharge piping, header piping, including all necessary bends, fittings, valves, tie in to existing force main, and appurtenances, Complete in Place.	LS	1	$_____	$_____
27	Remove & Replace Lift Station Pumps, Complete in Place.	EA	3	$_____	$_____
28	Site Paving, Complete in Place.	SY	241	$_____	$_____
29	Site Fencing & Gates, Complete in Place.	LF	192	$_____	$_____
30	Electrical Improvements as shown on Sheets 59-62, Complete in Place.	LS	1	$_____	$_____
Subtotal Lift Station 51 Items, Bid Items 24-30				$_____	

Initials _____

LIFT STATION 53 ITEMS

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total Amount
31	Valve Vault Abandonment, Complete in Place.	LS	1	$_____	$_____
32	Wet Well Rehabilitation, including but not limited to new access hatches, cleaning, grouting, and Spectrashield lining, Complete in Place.	LS	1	$_____	$_____
33	Remove & Replace L including discharge p including all necessary bends, fittings, valves, tie in to existing force main, and appurtenances, Complete in Place.	LS	1	$_____	$_____
34	Remove & Replace Lift Station Pumps, Complete in Place.	EA	2	$_____	$_____
35	Electrical Improvements as shown on Sheets 63-66, Complete in Place.	LS	1	$_____	$_____
Subtotal Lift Station 53 Items, Bid Items 31-35				$_____	

NOT IN THIS CONTRACT

Initials _____

LIFT STATION 55 ITEMS

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Total Amount
36	Valve Vault Abandonment, Complete in Place.	LS	1	$_____	$_____
37	Wet Well Rehabilitation, including but not limited to new access hatches, cleaning, grouting, and Spectrashield lining, Complete in Place.	LS	1	$_____	$_____
38	Remove & Replace Lift Station Piping, including discharge piping, header piping, including all necessa valves, tie in to existi appurtenances, Com.	NOT IN THIS CONTRACT		$_____	$_____
39	Remove & Replace Lift Station Pumps, Complete in Place.	EA	2	$_____	$_____
40	Site Paving, Complete in Place.	SY	35	$_____	$_____
41	Site Fencing & Gates, Complete in Place.	LF	90	$_____	$_____
42	Electrical Improvements as shown on Sheets 67-70, Complete in Place.	LS	1	$_____	$_____
Subtotal Lift Station 55 Items, Bid Items 36-42				$_____	

TOTAL BASE BID ITEMS	$_____

Initials _____

SUMMATION

SUBTOTAL MISCELLANEOUS ITEMS 1-4	$
SUBTOTAL LIFT STATION 13 ITEMS 5-8	$
SUBTOTAL LIFT STATION ~~18~~ ITEMS ~~9-16~~ NOT IN THIS CONTRACT	
SUBTOTAL LIFT STATION ~~53~~ ITEMS ~~31-35~~ NOT IN THIS CONTRACT	$
SUBTOTAL LIFT STATION 51 ITEMS 24-30	$
SUBTOTAL LIFT STATION ~~53~~ ITEMS ~~31-35~~ NOT IN THIS CONTRACT	
SUBTOTAL LIFT STATION ~~55~~ NOT IN THIS CONTRACT	$
TOTAL BASE BID ITEMS ~~1-42~~ 1-8 & 24-30	$
TOTAL AMOUNT BID (BASE BID)	$

Company Name (Printed): _____

Printed Name of Signatory: _____

Signature: _____

Date: _____

Initials _____

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:

LIFT STATION #13 & #51 IMPROVEMENTS

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 _____2026.

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

APPROVED AS TO FORM:

Office of the City Attorney

NOTE: Attach Power of Attorney

"General Decision Number: TX20260033 01/02/2026

Superseded General Decision Number: TX20250033

State: Texas

Construction Type: Heavy Dredging

Counties: Texas Statewide.

DREDGING PROJECTS ALONG THE TEXAS GULF COAST AREA INCLUDING ALL PUBLIC CHANNELS, HARBORS, RIVERS, TRIBUTARIES AND THE GULF INTRACOASTAL WATERWAYS

Modification Number	Publication Date
0	01/02/2026

SUTX1994-001 01/18/1994

The following rates were revised pursuant to 29 CFR 1.6(c)(1) on 02/07/2025.

	Rates	Fringes
Derrick Operator	$ 16.85	
Dozer Operator	$ 16.85	
Dredge 16"" and Over		
DECKHAND	$ 16.85	
DREDGE TENDER OPERATOR	$ 16.85	
FIREMAN	$ 16.85	
FIRST ASSISTANT ENGINEER	$ 16.85	
LEVERMAN	$ 16.85	
OILER	$ 16.85	
SECOND ASSISTANT ENGINEER	$ 16.85	
SHOREMAN	$ 16.85	
THIRD ASSISTANT ENGINEER	$ 16.85	
TRUCK DRIVER	$ 16.85	
WELDER	$ 16.85	
Dredge Under 16""		
DECKHAND	$ 16.85	
DREDGE TENDER OPERATOR	$ 16.85	
LEVERMAN	$ 16.85	
OILER	$ 16.85	
WELDER	$ 16.85	
Hydraulic Dredging		
FIRST COOK	$ 16.85	
HANDYMAN	$ 16.85	
JANITOR - CABIN PERSON	$ 16.85	
MESS PERSON	$ 16.85	
SECOND COOK	$ 16.85	
Marsh Buggy Dragline		
OILER	$ 16.85	
OPERATOR	$ 16.85	

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

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

Note: Executive Order 13658 generally applies to contracts subject to the Davis-Bacon Act that were awarded on or between January 1, 2015 and January 29, 2022, and that have not been renewed or extended on or after January 30, 2022. Executive Order 13658 does not apply to contracts subject only to the Davis-Bacon Related Acts regardless of when they were awarded. If a contract is subject to Executive Order 13658, 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 the contract in 2025. The applicable Executive Order minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under Executive Order 13658 is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (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 rehabilitation of Lift Stations 13, ~~18~~, ~~30~~, 51, ~~53~~, & ~~55~~ including installation of new pumps and construction of new header piping at each lift station.

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 (If Applicable):

There are no alternates included in the Project.

1.04 WORK BY OWNER

A. Items noted as Not in Contract (NIC), (Provide general description of NIC items to be furnished by Owner, if applicable), will be furnished and installed by Owner.

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

N/A

C. The Contractor will remove, palletize, and deliver to the City the following:

1. Pumps

2. Control Panels

Note, that pumps and control panels may be used for by-pass pumping at the Contractor's risk if approved by the City. Damage incurred during use for by-pass pumping beyond normal "wear and tear" will be repaired before equipment is turned over to the City.

1.05 OWNER FURNISHED PRODUCTS

A. Products purchased and paid for by Owner:

1. None.

B. Contractor's Responsibilities:

Arrange and pay for product delivery to site.

Receive and unload products at site; jointly with Owner's Representative, inspect for completeness or damage.

Handle, store, install, and finish products.

Repair or replace damaged items.

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 to accommodate Owner occupancy requirements during the construction period, coordinate construction schedule and operations with Owner's Representative.

1.07 FUTURE WORK (IF APPLICABLE)

A. Section Not Applicable.

1.08 UTILITY OUTAGE AND SHUTDOWN

A. Contractor shall notify the City by email to publicworks@galvestontx.gov and by phone at 409-797-3630 at least 48 hours in advance of shutting down any roads or alleyways.

B. Contractor shall notify the City at least 48 hours in advance of shutting down any water or sanitary sewer service.

1.09 OWNER OCCUPANCY

A. The Owner intends for the Contractor to maintain normal operation of all utility services and traffic flow located within the project limits.

B. The Owner will occupy the lift station sites during the entire period of construction for the conduct of normal operations.

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

D. Schedule work to accommodate this requirement.

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

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 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: _____

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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.

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TCEQ Central Registry Core Data Form
The Core Data Form has been incorporated into this form. **Do not send a core data form to TCEQ.**

After final acknowledgment of coverage under the general permit, the program will assign a Customer Number (CN) and Regulated Entity Number (RN). For Construction Permits, a new RN will be assigned for each Notice of Intent filed with TCEQ, since construction project sites can overlap with other Customers. The RN assigned to your construction project will not be assigned to any other TCEQ authorization.

You can find the information on the Central Registry web site at www4.tceq.state.tx.us/crpub. You can search by the Regulated Entity (RN), Customer Number (CN) or Name (Permittee), or by your permit number under the search field labeled "Additional ID". Capitalize all letters in the permit number.

The Customer (Permittee) is responsible for providing consistent information to the TCEQ, and for updating all CN and RN data for all authorizations as changes occur. For General Permits, a Notice of Change form must be submitted to the program area.

Application Fees:

$225.00 application fee if submitting the NOI through ePermits.
$325.00 application fee if submitting a paper NOI for processing.

The application fee is required to be paid at the time the NOI is submitted. Failure to submit payment at the time the application is filed will cause delay in acknowledgment or denial of coverage under the general permit.

• Mailed Payments:
DO NOT mail your check with the original Notice of Intent application.
Use the attached Application Fee payment submittal form is mailing the payment. Do not include a copy of the NOI.

BY REGULAR U.S. MAIL
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
P.O. Box 13088
Austin, TX 78711-3088

BY OVERNIGHT/EXPRESS MAIL
Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
12100 Park 35 Circle
Austin, TX 78753

• ePAY Electronic Payment:
Go to https://www6.tceq.state.tx.us/epay
Select Water Quality, then select the fee category "GENERAL PERMIT CONSTRUCTION STORM WATER DISCHARGE NOI APPLICATION".
You must include a copy of the payment voucher with your NOI. Your NOI will not be considered complete without the payment voucher.

The Annual Water Quality Fee has been consolidated into the Application Fee effective March 5, 2008. An annual fee will not be assessed and billed to operators on 9/1/2008. This does not relieve the operator of fees due for prior fiscal year assessments.

The operator will continue to receive an invoice for payment of any past due annual fee. A 5% penalty will be assessed if the payment is received by TCEQ after the due date. Annual fee assessments cannot be waived as long as the authorization under the general permit was active on September 1 of the FY billed.

ATTACHMENT 1

INSTRUCTIONS FOR FILLING OUT THE NOI FORM

A. OPERATOR (As defined in the general permit.)

1. TCEQ Issued Customer Number (CN)
TCEQ's Central Registry will assign each customer a number that begins with "CN," followed by nine digits. **This is not a permit number**, registration number, or license number.
- If this customer has not been assigned a Customer Reference Number, leave the space for the Customer Reference Number blank.
- If this customer has already been assigned this number, enter the operator's Customer Reference Number in the space provided.

2. Legal Name
Provide the legal name of the facility operator, as authorized to do business in Texas. The name must be provided exactly as filed with the Texas Secretary of State (SOS), or on other legal documents forming the entity, that is filed in the county where doing business. You may contact the SOS at 512/463-5555, or go to http://www.sos.state.tx.us/corp/contact.shtml for more information related to filing in Texas. If filed in the county where doing business, provide a copy of the legal documents showing the legal name.

3. Name and Title of person signing the Notice of Intent application form. Signature meets 30 Texas Administrative Code (TAC) §305.44

4. Operator Mailing Address
Provide a complete mailing address for receiving mail from the TCEQ. The address must be verifiable with the US Postal Service at www.usps.com, for regular mail delivery (not overnight express mail). If you find that the address is not verifiable using the USPS web search, please indicate the address is used by the USPS for regular mail delivery.

5. Phone Number
This number should correspond to this customer's mailing address given earlier. Enter the area code and phone number here. Leave "Extension" blank if this customer's phone system lacks this feature.

6. Fax Number and E-mail Address
This number and E-mail address should correspond to operator's mailing address provided earlier. (Optional Information)

7. Type of Entity
Check only one box that identifies the type of entity. Use the descriptions below to identify the appropriate entity type:

Individual is a customer who has not established a business, but conducts an activity that needs to be regulated by the TCEQ.

Sole Proprietorship— D.B.A. is a customer that is owned by only one person and has not been incorporated. This business may:
- be under the person's name
- have its own name ("doing business as," or d.b.a.)
- have any number of employees

Partnership is a customer that is established as a partnership as defined by the Texas Secretary of State's Office.

Corporation is a customer that meets all of these conditions:
- is a legally incorporated entity under the laws of any state or country
- is recognized as a corporation by the Texas Secretary of State
- has proper operating authority to operate in Texas.

Government - Federal, state, county, or city government (as appropriate)
the customer is either an agency of one of these levels of government or the governmental body itself.

Other is Estate, Trust, etc.
the customer does not fit one of the above descriptions. Enter a short description of the type of customer in the blank provided.

8. Independent Operator
Check "No" if this customer is a subsidiary, part of a larger company, or is a governmental entity. Otherwise, check "Yes."

9. Number of Employees
Check one box to show the number of employees for this customer's entire company, at all locations. This is not necessarily the number of employees at the site named in the NOI.

10. State Franchise Tax ID Number
Corporations and limited liability companies that operate in Texas are issued a franchise tax identification number. If this customer is a corporation or limited liability company, enter this number here.

Federal Tax ID
All businesses, except for some small sole proprietors, individuals, or general partnerships should have a federal taxpayer identification number (TIN). Enter this number here. Use no prefixes, dashes, or hyphens. Sole proprietors, individuals, or general partnerships do not need to provide a federal tax ID.

TX SOS Charter (filing) Number
Corporations and Limited Partnerships required to register with the Texas Secretary of State are issued a charter or filing number. You may obtain further information by calling SOS at 512/463-5555 http://www.sos.state.tx.us/corp/contact.shtml.

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DUNS Number
Most businesses have a DUNS (Data Universal Numbering System) number issued by Dun and Bradstreet Corp. If this customer has one, enter it here.

B. Application Contact

Provide the name, title and communication information of the person that TCEQ can contact for additional information regarding this application.
If the application is missing information and there is no contact person to call, the application may be denied.

C. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

1. Regulated Entity Reference Number (RN)

This is a number issued by TCEQ's Central Registry to sites (a location where a regulated activity occurs) regulated by TCEQ. This is not a permit number, registration number, or license number.

- If this Regulated Entity has not been assigned a Regulated Entity Number, leave this space blank.
- If this customer has been assigned this number, enter the operator's Regulated Entity Number.

2. Site/Project Name/Regulated Entity
If the site is already regulated by TCEQ, use the same name as on the existing Regulated Entity Reference Number (RN).

If new, provide the name of the site as known by the public in the area where the site is located. The name you provide on this application will be used in the TCEQ Central Registry as the Regulated Entity.

3. Site/Project (RE) Physical Address

Section A: Enter the complete physical address of where the site is located. This must be a street number and street name for a complete physical address. This address must be validated through US Postal Service or your local police (911 service) as a valid address. Please confirm this to be a complete and valid address. In some rural areas, new addresses are being assigned to replace rural route addresses.
Please do not use a rural route or post office box for a site location.

Section B: If a site does not have an actual physical address that includes a street number and street name, then provide a complete written location access description, and the zip code and city where the site is located.
For example: "The site is located 2 miles west from intersection of Hwy 290 & IH35, located on the southwest corner of the Hwy 290 South bound lane." This includes authorizations for construction projects such as highways and subdivision.

4. Identify the County where the site is located. If the site covers more than one county, provide the county that is most affected by the authorized activity and list the additional county(s) as secondary.

5. Latitude and Longitude
Enter the latitude and longitude of the site in either degrees, minutes, and seconds or decimal form. For help obtaining the latitude and longitude, go to: TCEQ USGS Topographic Map Viewer or TerraServer-USA

6. Description of Activity Regulated
In your own words, briefly describe the primary business being conducted at the site. (A description specific to what you are doing that requires this authorization - Do not repeat the SIC Code(s).)

SITE MAILING ADDRESS

Provide a complete mailing address to be used by TCEQ for receiving mail at the site. In most cases, the address is the same as the operator. If so, simply place a check mark in the box. If you provide a different address, please verify the address with USPS as instructed above for the operator address.

D. GENERAL CHARACTERISTICS

1. **Indian Country Lands**
If your site is located on Indian Country Lands, the TCEQ does not have authority to process your application. You must obtain authorization through EPA, Region VI, Dallas. Do not submit this form to TCEQ.

Indian Country means (1) all land within the limits of any American Indian reservation under the jurisdiction of the U.S. government, notwithstanding the issuance of any patent, and including rights-of-way running throughout the reservation; (2) all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or outside the limits of a State; and (3) all Indian allotments, the Indian titles which have not been extinguished, including rights-of-way running through the same.

Indian Tribe means any Indian Tribe, band, nation, or community recognized by the Secretary of the Interior and exercising substantial governmental duties and powers.

2. **Standard Industrial Classification (SIC) code**
Provide the SIC code that best describes the construction activity being conducted at the site.
Common SIC Codes related to construction activities include: 1521 Construction of Single Family Homes; 1522 Construction of Residential Bldgs. Other than Single Family Homes; 1541 Construction of Industrial Bldgs. and Warehouses; 1542 Construction of Non-residential Bldgs. other than Industrial Bldgs. and Warehouses; 1611 Highway & Street Construction, except Highway Construction; 1622 Bridge, Tunnel, & Elevated Highway Construction; 1623 Water, Sewer, Pipeline & Communications, and Power Line Construction. For help with SIC codes, go to: www.osha.gov/oshstats/sicser.html

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3. **Estimated Area of Land Disturbed**
3(a). Provide the approximate number of acres that the construction site will disturb.
3(b). Indicate is the site is part of a common plan of development or for sale.

Construction activities that disturb less than one acre, unless they are part of a larger common plan that disturbs more than one acre, do not require permit coverage.

Construction activities that disturb between one and five acre, unless they are part of a common plan that disturbs five acres or more acres, do not require submission of an NOI. Therefore, the estimated area of land disturbed should not be less than five, unless the project is part of a larger common plan that disturbs five or more acres.

"Disturb" means any clearing, grading, excavating, or other similar activities. If you have any questions about this item, please call the storm water technical staff at (512)239-4671.

4. **Discharge Information**
4 (a). The storm water may be discharged directly to a receiving stream or through a **MS4*** from your site. It eventually reaches a receiving water body such as a local stream or lake, possibly via a drainage ditch. You must provide the name of the water body that receives the discharge from the site (a local stream or lake).

4 (b). The classified segment number(s) is REQUIRED to get coverage. Go to the link to find the segment number of the classified water body where storm water will flow http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/viewer/viewer.html . Call Water Quality Assessments at 512/239-4671 for further assistance. Another source for segments is: http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/gi/gi-316/index.html

4 (c). If any surface water body(s) receiving discharges from the construction site are on the latest EPA-approved CWA § 303(d) list of impaired waters, provide the name(s) of the water body(s).

EPA approved CWA 303d list of impaired waters can be found at: Texas Water Quality Inventory and 303(d) List - Texas Commission on Environmental Quality - www.tceq.state.tx.us

4 (d). Identify the **MS4*** Operator name if the storm water discharge is into an MS4.

***MS4 is an acronym for Municipal separate storm sewer system. MS4 is defined as** a separate storm sewer system owned or operated by a state, city, town, county, district, association, or other public body (created by or pursuant to state law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under state law such as a sewer district, flood control or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, that discharges to water in the state.

For assistance, you may call the technical staff of the Water Quality Assessment & Standards Section at 512/239-4671.

4 (e). **Edwards Aquifer Rule**
See maps on the TCEQ website to determine if the site is located within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer at http://www.tceq.state.tx.us/compliance/field_ops/eapp/viewer.html.

If the discharge or potential discharge is within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer, a site specific authorization approved by the Executive Director under the Edwards Aquifer Protection Program (30 TAC Chapter 213) is required before construction can begin.

The general permit requires the approved Contributing Zone Plan or Water Pollution Abatement Plan to be included as a part of the Storm Water Pollution Prevention Plan. The certification must be answered "Yes" for coverage under the general permit.

E. CERTIFICATIONS

Failure to indicate "Yes" to ALL of the certification items may result in denial of coverage under the general permit.

The certification must bear an original signature of a person meeting the signatory requirements specified under **30 Texas Administrative Code §305.44**

IF YOU ARE A CORPORATION:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(1) (see below). According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

IF YOU ARE A MUNICIPALITY OR OTHER GOVERNMENT ENTITY:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(3) (see below). According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statute(s) under which your government entity was formed. An NOI or

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. Filter fabric fence will be measured by the linear foot, or lump sum as specified in the bid proposal for the project, of completed and accepted filter fabric fence between the limits of the beginning and ending of wooden stakes. Filter fabric fence, measured as stated, will be paid for at the unit price bid for Filter Fabric Fence, Complete in Place.

B. Payment for filter fabric fence will include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to protection of trees, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, and removal of erosion and sediment control systems at the end of construction.

1.03 SUBMITTALS

A. Manufacturer’s catalog sheets and other product data on geotextile fabric.

PART 2 P R O D U C T S

2.01 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric shall have a grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140.

C. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. Provide erosion and sediment control systems at the locations shown on Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than site work specifically directed by the Owner's Representative to allow soil testing and surveying.

C. Regularly inspect and repair or replace damaged components of filter fabric fences as specified in this Section. Unless otherwise directed, maintain the erosion and sediment control systems until the project area stabilization is accepted by the Owner. Remove erosion and sediment control systems promptly when directed or approved by the Owner's Representative. Discard removed materials off site.

D. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at a location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

E. Conduct all construction operations under this Contract in conformance with the erosion control practices described in Section 01566 - Source Controls for Erosion and Sedimentation.

3.02 CONSTRUCTION METHODS

A. Provide filter fabric fence systems in accordance with the Drawing detail for Filter Fabric Fences. Filter fabric fences shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the filter fabric to 2-inch by 2-inch wooden stakes spaced a maximum of 3 feet apart and embedded a minimum of 8 inches. If filter fabric is factory preassembled with support netting, then maximum spacing allowable is 8 feet. Install wooden stakes at a slight angle toward the source of anticipated runoff.

C. Trench in the toe of the filter fabric fence with a spade or mechanical trencher as shown on the Drawings. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.

E. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

F. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately. Remove sediment deposits when silt reaches a depth one-third the height of the fence or 6 inches, whichever is less.

END OF SECTION

SECTION 01568

REINFORCED FILTER FABRIC BARRIER

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of reinforced filter fabric barriers for erosion and sediment control used during construction and until the final development of the site. Reinforced filter fabric barriers are used to retain sedimentation in channelized flow areas.

1.02 UNIT PRICES

A. Filter fabric barrier will be measured by the linear foot of completed and accepted filter fabric barrier between the limits of the beginning and ending fence posts. Filter fabric barrier, measured as stated, will be paid for at the unit price bid for Reinforced Filter Fabric Barrier, Complete in Place.

B. Payment for filter fabric barrier will include and be full compensation for all labor, equipment, materials, supervision, and incidental expenses for construction of these items, complete in place, including, but not limited to protection of trees, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, and removal of erosion and sediment control systems at the end of construction.

1.03 SUBMITTALS

A. Manufacturer's catalog sheets and other product data on geotextile fabrics.

PART 2 P R O D U C T S

2.01 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric shall have a minimum grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140.

C. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.

2.02 FENCING

A. Provide woven galvanized steel wire fence with minimum thickness of 14 gauge and a maximum mesh spacing of 6 inches.

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. Provide erosion and sediment control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner's Representative to allow soil testing and surveying.

C. Regularly inspect and repair or replace damaged components of the reinforced filter fabric barrier as specified in this Section. Unless otherwise directed, maintain the erosion and sediment control systems until the project area stabilization is accepted by the Owner. Remove erosion and sediment control systems promptly when directed by the Owner's Representative. Discard removed materials off site.

D. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at a location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

E. Conduct all construction operations under this Contract in conformance with the erosion control practices described in Section 01566 - Source Controls for Erosion and Sedimentation.

3.02 CONSTRUCTION METHODS

A. Provide filter fabric barriers in accordance with the Drawing detail for Reinforced Filter Fabric Barrier. Filter fabric barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the woven wire support to 2-inch by 2-inch wooden stakes spaced a maximum of 6 feet apart and embedded a minimum of 8 inches. Install wooden stakes at a slight angle toward the source of the anticipated runoff.

C. Trench in the toe of the filter fabric barrier with a spade or mechanical trencher as shown on the Drawings. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Securely fasten the filter fabric material to the woven wire with tie wires.

E. Reinforced filter fabric barrier shall have a height of 18 inches.

F. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

G. Inspect the reinforced filter fabric barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately. Remove sediment deposits when silt reaches a depth one-third the height of the barrier or 6 inches, whichever is less.

END OF SECTION

SECTION 01569

STABILIZED CONSTRUCTION EXIT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of erosion and sediment control for stabilized construction exits used during construction and until final development of the site.

1.02 SUBMITTALS

A. Manufacturer's catalog sheets and other product data on geotextile fabric.

B. Sieve analysis of aggregates conforming to requirements of this Specification.

1.03 UNIT PRICES

A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.

PART 2 P R O D U C T S

2.01 GEOTEXTILE FABRIC

A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric shall have grab strength of 270 psi in any principal direction (ASTM D-4632), and the equivalent opening size between 50 and 140.

C. Both the geotextile and threads shall be resistant to chemical attack, mildew, and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable life at a temperature range of 0ºF to 120ºF.

D. Representative Manufacturers: Mirafi, Inc., or equal.

2.02 COARSE AGGREGATES

A. Coarse aggregate shall consist of crushed stone, gravel, crushed concrete, or a combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, rebar, shale, soft or flaky materials, or organic and injurious matter.

B. Coarse aggregates shall conform to the following gradation requirements.

Sieve Size (Square Mesh)	Percent Retained (By Weight)
2-1/2"	0
2"	0 – 20
1-1/2"	15 – 50
¾"	60 – 80
No. 4	95 - 100

PART 3 E X E C U T I O N

3.01 PREPARATION AND INSTALLATION

A. If necessary to keep the street clean of mud carried by construction vehicles and equipment, Contractor shall provide stabilized construction roads and exits at the construction, staging, parking, storage, and disposal areas. Such erosion and sediment controls shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner's Representative to allow soil testing and surveying.

C. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by the Owner's Representative to remove and discard the existing system.

D. Regularly inspect and repair or replace components of stabilized construction exits. Unless otherwise directed, maintain the stabilized construction roads and exits until the project is accepted by the City. Remove stabilized construction roads and exits

promptly when directed by the Owner's Representative. Discard removed materials off site.

E. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at a permitted location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

F. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.

G. Conduct all construction operations under this Contract in conformance with the erosion control practices described in the relevant sections of these specifications.

3.02 CONSTRUCTION METHODS

A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.

B. Provide stabilized construction exits, and truck washing areas when approved by Owner's Representative, of the sizes and locations where shown on Drawings or as specified in this Section.

C. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas which drain into a drainage system protected by erosion and sediment control measures.

D. Details for stabilized construction exit may be shown on the Drawings. Construction of all other stabilized areas shall be to the same requirements. Roadway width shall be at least 14 feet for one-way traffic and 20 feet for two-way traffic and shall be sufficient for all ingress and egress. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of 14 days to minimize damage potential.

E. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering public right-of-way, receiving stream or storm water conveyance system.

F. The stabilized areas shall be inspected and maintained daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged control measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.

G. The length of the stabilized area may be as shown on the Drawings, but not less than 50 feet. The thickness shall not be less than 8 inches. The width shall not be less than full width of all points of ingress or egress.

H. Stabilization for other areas shall have the same coarse aggregate, thickness, and width requirements as the stabilized construction exit, except where shown otherwise on the Drawings.

I. Stabilized area may be widened or lengthened to accommodate truck washing area when authorized by Owner's Representative.

J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by the Owner's Representative. These methods include the following:

1. Cement-Stabilized Soil - Compacted cement-stabilized soil or other fill material in an application thickness of at least 8 inches.

2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge-to-edge and across support wooden beams which are placed on top of existing soil in an application thickness of at least 6 inches.

3. Steel Mats - Perforated mats placed across perpendicular support members.

END OF SECTION

SECTION 01570

TRAFFIC CONTROL AND REGULATION

PART 1 G E N E R A L

.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.

.02 SUBMITTALS

A. Make submittals in accordance with Section 01300 - Submittals

.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.

.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

.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

.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.

.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.

.03 FLARES AND LIGHTS

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

.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.

.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.

.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.

.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.

.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

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 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 02222

BORROW

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Soil materials for embankment.

B. Not to include beach or dune projects.

1.02 UNIT PRICES

A. Payment for borrow is on cubic yard basis calculated by compacted volume quantities using average end area method based on the Construction Drawings.

B. Borrow shall be measured at the site of embankment.

1.03 SUBMITTALS

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

B. Submit location and description of proposed borrow area for approval. Borrow pits located on Galveston Island will require an excavation permit issued by the City.

C. Submit material samples for testing.

1.04 TESTS

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

PART 2 P R O D U C T S

2.01 SOIL MATERIAL

A. Excavated material shall be graded free of lumps greater than 6 inches, rocks larger than 3 inches, organic material, chemical waste or other contamination, and debris. Take borrow material from sources approved by Owner’s Representative.

B. Material to be used for topsoil shall meet or exceed requirements for soil materials of Section 02920 - Topsoil.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Notify Owner's Representative and testing laboratory 5 days in advance of opening borrow source to permit obtaining samples for qualification testing.

B. Clear approved source of trees, stumps, brush, roots, vegetation, organic matter, and other unacceptable material.

3.02 EXCAVATION

A. Provide adequate drainage of surface water so that surface water run off does not enter borrow pit excavation.

3.03 HAULING

A. Use covered trucks. Conform to requirements of Section 01570 - Traffic Control and Regulation and all local, County and State requirements.

3.04 EMBANKMENT

A. Conform to requirements of Section 02221 - Embankment.

END OF SECTION

SECTION 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 02228

EXTRA UNIT PRICE WORK FOR EXCAVATION AND BACKFILL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Measurement and payment applicable to extra Work items required for utility installations which are identified in the Proposal Form, and which have been authorized in advance by the Owner's Representative and made necessary by unusual or unforeseen circumstances encountered during utility excavation.

1.02 UNIT PRICES

A. Special excavation: Measurement for special excavation is on a cubic yard basis, measured in place, without deduction for space occupied by portions of pipes, ducts, or other structures left in place across trenches excavated under this item.

1. Cost for item shall include:

a. Dewatering and surface water control.

b. Protection of pipes, ducts, or other structures encountered including bracing, shoring, and sheeting necessary for support.

c. Replacement of pipes, ducts, or structures damaged by special excavation operations, except where payment for replacement is authorized by Owners Representative due to deteriorated condition of pipes, ducts, or structure.

d. Temporary disconnecting, plugging, and reconnecting of low volume water pipes, to allow machine excavation or augering, when approved by Owner's Representative. Pipe for replacement shall be new and conform to specification requirements for type of existing pipe removed.

e. Resodding required for surface restoration within designated limits of special excavation.

f. Disposal of excess excavated material not suitable for bedding or backfill, or not required for the Project.

2. Include cost for following items in payment for applicable Division 2 Sections:

a. Trench safety system including sheeting and shoring.

b. Utility piping installed in trenches excavated under this item.

c. Removal and replacement of associated streets, driveways, and sidewalks.

B. Extra hand or machine excavation: Measurement for extra hand excavation is on a cubic yard basis, measured in place.

1. Cost for item shall include:

a. Dewatering and surface water control.

b. Disposal of excess excavated material not suitable for bedding or backfill, or not required for the Project.

2. Include cost for placement of extra hand excavation in payment for Extra Work Bid Item for Extra Placement of Material.

3. Include cost for following items in payment for applicable Division 2 Sections:

a. Trench safety system including sheeting and shoring.

b. Removal and replacement of associated streets, driveways, and sidewalks.

C. Extra placement of material:

1. Measurement for extra placement of material is on a cubic yard basis, measured in place. At the discretion of Owner's Representative, measurement of cubic yards may be calculated from the volume of Extra Hand Excavation or Extra Machine Excavation for which placement is made, minus the volume of any Extra Placement of Special Backfill authorized in conjunction with the Work.

2. Cost for this item shall include resodding required for surface restoration within designated limits of Extra Hand Excavation or Extra Machine Excavation.

D. Extra placement of special excavation:

1. Measurement for extra placement of special material is on a cubic yard basis, measured in place.

2. Cost for this item shall include geotextile material and concrete trench dams required to complete the placement of special material conforming to the Specifications.

E. No payment will be made for delays in completion of Work resulting from extra unit price Work.

F. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Special excavation: Excavation necessitated by obstruction of pipes, ducts, or other structures, not shown on Drawings, which interfere with installation of utility piping by normal methods of excavation or augering. Contractor shall be responsible for locating such underground obstructions, sufficiently in advance of trench excavation or augering, to preclude damage to the obstructions.

B. Extra hand excavation: Excavation by manual labor at locations designated by the Owner Representative, which is not included in, or is incidental to, bid items contained in the Schedule of Unit Prices.

C. Extra machine excavation: Excavation by machine at locations designated by the Owner Representative, which is not included in, or is incidental to, bid items contained in the Schedule of Unit Prices.

D. Extra replacement of material: Handling, backfill, and compaction of excavated material authorized under Extra Work Bid Items for Extra Hand Excavation or Extra Machine Excavation. Placement and compaction shall conform to requirements specified in appropriate Division 2 Sections.

E. Extra placement of special backfill: Hauling, placing, and consolidating of special materials in conjunction with Extra Work Bid Item Extra Replacement of Material at locations designated by the Owner's Representative. Materials placed under this item shall conform to requirements for Bank Run Sand, Cement Stabilized Sand, Concrete Sand, Pea Gravel, Gem Sand, or Crushed Stone specified in Division 2 Sections.

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

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

END OF SECTION

SECTION 02229

UTILITY BACKFILL MATERIALS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Material Classifications

B. Utility Backfill Materials

1. Concrete sand.

2. Gem sand.

3. Pea gravel.

4. Crushed stone.

5. Crushed concrete.

6. Bank run sand.

7. Select backfill.

8. Random backfill.

C. Material handling and quality control requirements.

1.02 UNIT PRICES

A. No payment will be made for backfill material unless specifically listed in the Proposal Form. Include payment in unit price for applicable utility installation.

B. Measurement for backfill material, when included as a separate pay item, is on a cubic yard basis for material placed and compacted within theoretical trench width limits and thickness of material according to Drawing details.

C. Measurement for backfill of authorized over-excavation is in accordance with Section 02228 - Extra Unit Price Work for Excavation and Backfill.

D. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 DEFINITIONS

A. Backfill: Suitable material meeting specified quality requirements for the designated application as embedment or trench zone backfill.

B. Embedment: Material placed under controlled conditions within the embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.

C. Trench Zone Backfill: Material meeting specified quality requirements and placed under controlled conditions in the trench zone from top of embedment zone to base course in paved areas or to the surface grading material in unpaved areas.

D. Foundation: Either suitable soil of the trench bottom, or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.

E. Source: A source selected by the Contractor for supply of embedment or trench zone backfill material. A selected source may be the project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.

F. Refer to Section 02227 - Excavation and Backfill for Utilities, for other definitions regarding utility installation by trench construction.

1.04 SUBMITTALS

A. Conform to requirements of all sections and provisions of these specifications.

B. Submit a description of source, material classification and product description, production method, and application of backfill materials.

C. Submit test results for samples of off-site backfill materials to comply with Paragraph 3.03, Material Quality Control.

D. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that the Owner’s Representative may obtain samples for verification testing.

E. Before stockpiling materials, submit a copy of temporary easement or approval from landowner for stockpiling backfill material on private property.

1.05 TESTS

A. Perform tests of sources for backfill material in accordance with Paragraph 3.03A of this section.

B. Verification tests of backfill materials may be performed by the Owner in accordance with Section 01410 - Testing Laboratory Services and in accordance with Paragraph 3.03B of this section.

C. Random fill obtained from the Project excavation as source is exempt from prequalification requirements by Contractor, but must be inspected for unacceptable materials based on ASTM D 2488.

PART 2 P R O D U C T S

2.01 MATERIAL CLASSIFICATIONS

A. Materials for backfill shall be classified for the purpose of quality control in accordance with the Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02 of this section.

B. Class Designations Based on Laboratory Testing:

1. Class I: Well graded sands and gravels, gravel-sand mixtures, crushed well graded rock, little or no fines (GW, SW)

   a. Plasticity Index: Nonplastic

   b. Gradation: D_{60}/D_{10} - greater than 4 percent. Amount passing No. 200 Sieve - less than or equal to 5 percent

2. Class II: Poorly graded gravels and sands, silty sands and gravels, little to moderate fines (GM, GP, SP, SM)

   a. Plasticity Index: Nonplastic to 4

   b. Gradation (GP, SP): Amount passing No. 200 Sieve - less than 5 percent

   c. Gradation (GM, SM): Amount passing No. 200 Sieve - between 12 percent and 50 percent

3. Class III: Clayey gravels and sands, poorly graded mixtures of sand, gravel, and clay (GC, SC)

   a. Plasticity Index: greater than 7

   b. Gradation: Amount passing No. 200 Sieve - between 12 percent and 50 percent

4. Class IV: Lean clays (CL)

   a. Plasticity Index: greater than 7

   b. Liquid Limit: less than 50

   c. Gradation: Amount passing No. 200 Sieve - greater than 50 percent

   d. Inorganic

5. Use soils with dual class designation according to ASTM D 2487 according to the more restrictive class.

2.02 PRODUCT DESCRIPTIONS

A. Soils classified as silt (ML), silty clay (CL - ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Owner's Representative. Soils classified as fat clay (CH) may be used as backfill materials where allowed by the applicable backfill installation specification. Refer to Section 02226 - Excavation and Backfill for Structures and Section 02227 - Excavation and Backfill for Utilities.

B. Provide backfill material that is free of stones greater than 3 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to the following limits for deleterious materials:

   1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.

   2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.

   3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.

C. Manufactured materials may be substituted for natural soil or rock products where indicated in the product specification, and approved by Owner's Representative, provided that the physical property criteria are determined to be satisfactory by testing.

D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by the Unified Soil Classification System (ASTM D 2487) meeting the following requirements:

1. Less than 15 percent passing the number 200 sieve when tested in accordance with ASTM C 136. The amount of clay lumps or balls not exceeding 2 percent.

2. Material passing the number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318:

   a. Liquid limit not exceeding 25.

   b. Plasticity index not exceeding 7.

E. Concrete Sand: Natural sand, manufactured sand, or a combination of natural and manufactured sand conforming to the requirements of ASTM C 33 and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8”	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

F. Gem Sand: Sand conforming to the requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing

3/8″	95 to 100
No. 4	60 to 80
No. 8	15 to 40

G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
2″	100
3/8″	85 to 100
No. 4	10 to 30
No. 8	0 to 10
N0. 16	0 to 5

H. Crushed Aggregates: All crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. All materials of one product delivered for the same construction activity from a single source.

2. Non-plastic fines.

3. Los Angeles abrasion test wear not exceeding 40 percent when tested in accordance with ASTM C 131.

4. Gradations, as determined in accordance with TEX-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment By Ranges of Nominal Pipes Sizes		
	>15″	15″ – 8″	<8″
1″	95 – 100	100	-

3/4"	60 – 90	90 – 100	100
1/2"	25 – 60	-	90 – 100
3/8"	-	20 – 55	40 – 70
No. 4	0 – 5	0 – 10	0 - 15
No. 8	-	0 – 5	0 - 5

5. Crushed stone: Produced from oversize quarried aggregate, sized by crushing from a naturally occurring single source. Crushed gravel or uncrushed gravel are not acceptable materials for utility embedment.

6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are the same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, base course material, reinforcing steel fragments, soil, debris, or deteriorated concrete fragments.

I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Section 02570 - Pavement Repair and Resurfacing, to meet plasticity criteria.

J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by the applicable backfill installation specification. Refer to Section 02226 - Excavation and Backfill for Structures and Section 02227 - Excavation and Backfill for Utilities.

K. Cement Stabilized Sand: Conform to requirements of Section 02252 - Cement Stabilized Sand.

L. Concrete Backfill: Conform to Class B concrete as specified in Section 03305 - Concrete for Utility Construction or Section 03310 - Concrete for Structures.

M. Pavement Restoration: Conform to requirements of Section 02570 - Pavement Repair and Resurfacing.

PART 3 E X E C U T I O N

3.01 SOURCES

A. Use of material encountered in the trench excavations is acceptable, provided applicable specification requirements are satisfied. If excavation material is not acceptable, provide from other source.

B. Obtain approval for each material source by the Owner's Representative before delivery is started. If sources previously approved do not produce uniform and satisfactory products, furnish materials from other approved sources. All materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet the requirements of the specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once a material is approved by the Owner's Representative, expense for sampling and testing required to change to a different material will be credited to the Owner through a change order.

C. Bank run sand, select backfill, and random backfill, if available in the Project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete the work from off-site sources.

D. The Owner does not represent or guarantee that any soil found in the excavation work will be suitable and acceptable as backfill material.

3.02 MATERIAL HANDLING

A. When backfill material is obtained from either a commercial or non-commercial borrow pit, have that pit opened to expose the vertical faces of the various strata of acceptable material to be used. Excavate the material by vertical cuts extending through the exposed strata to achieve uniformity in the product.

B. Establish temporary stockpile locations for practical material handling and control, and verification testing by the Owner's Representative in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.

C. When stockpiling backfill material near the Project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering the drainage system.

D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.03 MATERIAL QUALITY CONTROL

A. Ensure that material selected, produced and delivered to the Project meets applicable specifications and is of sufficient uniform properties to allow practical construction and quality control. Responsibilities include:

1. Source or Supplier Qualification. Perform testing, or obtain representative tests by suppliers, for selection of material sources and products. Provide test results for a minimum of three samples for each source and material type. Test samples of processed materials from current production representing material to be delivered. Tests shall verify that the materials meet specification requirements. Repeat qualification test procedures each time the source characteristic changes or there is a planned change in source location or supplier. Qualification tests shall include, as applicable:

    a. Gradation. Complete sieve analyses shall be reported regardless of the specified control sieves. The range of sieves shall be from the largest particle through the No. 200 sieve.

    b. Plasticity

    c. Los Angeles abrasion

    d. Clay lumps

    e. Light weight pieces

    f. Organic impurities

2. Production Testing. Establish a program to provide assurance that backfill materials delivered from the sources and placed in the Work meet applicable specification requirements. Report results to the Owner’s Representative.

3. Assist the Owner’s Representative in obtaining material samples for verification testing at the source or at the production plant.

4. Notify the Owner’s Representative in the field when non-conforming material is detected.

B. Quality Control

1. The Owner’s Representative may sample and test backfill at:

    a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.

    b. On-site stockpiles.

c. Materials placed in the Work.

2. The may Owner's Representative resample material at any stage of work or location if changes in characteristics are apparent.

3. The Owner's Representative will notify Contractor at the Project site about non-conforming materials and will, as appropriate, resample materials to verify results.

C. Tolerances

The following tolerances apply to production quality control testing.

1. Embedment Material and Select Backfill: The Owner's Representative may accept material provided that not more than one out of the most recent five consecutive tests is out of the specification limits for:

   a. Gradation: Not more than 5 percentage points on any individual sieve.

   b. Plasticity: Not more than 2 percentage points.

2. Trench Zone Backfill Material: Except for select and random backfill, the Owner's Representative may accept the material provided that not more than one out of the most recent three consecutive tests is out of the specification limits for:

   a. Gradation: Not more than 8 percentage points on any individual sieve.

   b. Plasticity: Not more than 5 percentage points.

3. Select and Random Backfill: No quantified tolerances. Remove non-conforming material identifiable by visual-manual procedure.

END OF SECTION

SECTION 02231

CRUSHED STONE FLEXIBLE BASE COURSE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of crushed stone.

1.02 UNIT PRICES

A. Measurement for crushed stone flexible base is on a square yard basis. Separate measurement will be made for each different required thickness of base course.

1.03 SUBMITTALS

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

B. Submit samples of crushed stone and soil binder for testing.

1.04 TESTS

A. Tests and analysis of soil materials will be performed in accordance with ASTM C131, ASTM D1557, ASTM D4318, Tex-101-E, and Tex-110-E under provisions of Section 01410 - Testing Laboratory Services.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stockpiles shall be made up of layers of processed aggregate materials. Load material by making successive vertical cuts through entire depth of stockpile.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Crushed Stone: Material retained on the No. 40 Sieve meeting the following requirements:

1. Durable particles of crusher-run broken limestone, sandstone, or granite obtained from an approved source.

2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C131.

B. Soil Binder: Material passing the No. 40 Sieve meeting the following requirements when tested in accordance with ASTM D4318:

1. Maximum Liquid Limit: 40.

2. Maximum Plasticity Index: 12.

3. Maximum Lineal Shrinkage: 7 (when calculated from volumetric shrinkage at liquid limit).

C. Mixed Materials shall meet the following requirements:

1. Minimum compressive strength of 35 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure using triaxial testing procedures.

2. Grading in accordance with Tex-101-E and Tex-110-E within the following limits:

Sieve	Percent Retained
1-3/4 inch	0 to 10
No. 4	45 to 75
No. 40	60 to 85

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Prepare subgrade in accordance with requirements of Section 02221 and Section 02225 or Sections 02241.

C. Correct subgrade deviations in excess of plus or minus 1/2 inch in cross section, or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

D. Prepare sufficient subgrade in advance of base course operations.

3.03 PLACEMENT

A. Spread and shape in lifts to compacted thickness not to exceed 8 inches. Complete spreading, shaping, and compacting on same day material is deposited.

B. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Secure a firm bond between reinforcement and base.

C. Start rolling operations as soon as possible after placement. Use sheepfoot, steel, or pneumatic rollers as approved. Roll longitudinally with subgrade starting from sides. Overlap successive strips by one-half width of each rear wheel.

D. Maintain moisture between optimum and 3 percent above optimum moisture.

E. Compact to 95 percent of Modified Proctor density in accordance with ASTM D1557, unless otherwise indicated on the Drawings.

F. Finish to grade and compact lift before placing successive lift.

G. Maintain shape by grading throughout operation.

H. Provide total thickness indicated on Drawings.

3.04 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top surface of embankment: Plus or minus 1/4 inch in cross section, or in 16 foot length.

3.05 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one core will be taken at random locations per 1,000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no additional cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 at a random location near each depth determination core. Rework and recompact areas that do not conform to compaction requirements.

E. Fill cores and density test sections with new compacted crushed stone flexible base.

3.06 PROTECTION

A. Sprinkle to prevent excessive loss of moisture.

B. Restrict construction traffic on finished base to equipment required to complete the work.

END OF SECTION

SECTION 02233

CEMENT STABILIZED BASE COURSE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of cement stabilized crushed stone.

B. Foundation course of cement stabilized bank run gravel.

1.02 UNIT PRICES

A. Measurement for Cement Stabilized Base Course is on a square yard basis. Separate measurement will be made for each different required thickness of base course.

B. Measurement for asphaltic seal cure is by the square yard.

1.03 SUBMITTALS

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

B. Submit samples of crushed stone, gravel, and soil binder for testing.

C. Submit weight tickets, certified by supplier, with each bulk delivery of cement to work site.

D. Submit manufacturer's description and characteristics for pug mill and associated equipment, spreading machine, and compaction equipment for approval.

1.04 TESTS

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Tests and analysis of aggregate and binder materials will be performed in accordance with ASTM D1557 and ASTM D4318.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Make stockpiles from layers of processed aggregate so as to eliminate segregation of materials. Load material by making successive vertical cuts through entire depth of stockpile.

B. Store cement in weatherproof enclosures. Protect from ground dampness.

PART 2 P R O D U C T S

2.01 CEMENT

A. ASTM C150 Type I; bulk or sacked.

2.02 WATER

A. Water: Clean; clear; and free from oil, acids, alkali, or vegetable matter.

2.03 AGGREGATE

A. Crushed Stone: material retained on the No. 40 Sieve meeting the following requirements:

1. Durable particles of crusher-run broken limestone obtained from an approved source.

2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C131.

B. Gravel: Durable particles of bank run gravel or processed material.

C. Soil Binder: Material passing the No. 40 Sieve meeting the following requirements when tested in accordance with ASTM D4318:

1. Maximum Liquid limit: 35.

2. Maximum Plasticity index: 10.

D. Mixed aggregate and soil binder shall meet the following requirements:

1. Grading in accordance with Tex-101-E and Tex-110-E within the following limits:

Sieve	Percent Retained			
	Crushed Stone	Processed GR. 1	Gravel GR. 2	Bankrun Gravel
1-3/4”	0 to 10	0 to 5	-	0 to 5
1/2"	-	-	0	-
No. 4	45 to 75	30 to 75	15 to 35	30 to 75
No. 40	55 to 80	60 to 85	55 to 85	65 to 85

2. Obtain prior permission from Owner’s Representative for use of additives to meet above requirements.

2.04 ASPHALTIC SEAL CURE

A. Cut back asphalt: MC30 conforming to requirements of Section 02511.

B. Emulsified petroleum resin: EPR-1 Prime conforming to requirements of Section 02511.

2.05 MATERIAL MIX

A. Design mix for minimum average compressive strength of 200 psi at 48 hours using Tex-120-E unconfined compressive strength testing procedures. Provide minimum cement content of 1-1/2 sacks, weighing 94 pounds each sack, per ton of mix.

B. Increase cement content if average compressive strength of tests on field samples fall below 200 psi. Refer to Part 3 concerning field samples and tests.

C. Mix in stationary pug mill equipped with feeding and metering devices which shall add specified quantities of base material, cement, and water into mixer. Dry mix base material and cement sufficiently to prevent cement balls from forming when water is added.

D. Resulting mixture shall be homogeneous and uniform in appearance.

2.06 SOURCE QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Testing for unconfined compressive strength will be performed by Test Method Tex-120-E as follows:

1. Three samples will be molded each day or for each 1,000 tons of production.

2. Compressive strength shall be the average of three tests for each production lot.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Prepare subgrade in accordance with requirements of Section 02221 and Section 02225 or Sections 02241.

C. Correct subgrade deviations in excess of plus or minus 1/2 inch in cross section, or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

D. Prepare sufficient subgrade in advance of base course for efficient operations.

3.03 PLACEMENT

A. Do not mix and place cement stabilized base when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.

B. Place material on prepared subgrade in uniform layers to produce thickness indicated on Drawings. Depth of layers shall not exceed 8 inches. Do not dump material in piles or windrows.

C. Spread with approved spreading machine. Conduct spreading so as to eliminate planes of weakness or pockets of nonuniformly graded material resulting from hauling and dumping operations.

D. Provide construction joints between new material and stabilized base that has been in place 4 hours or longer. Joints shall be approximately vertical. Form joint with a

temporary header or make vertical cut of previous base immediately before placing subsequent base.

E. Use only one longitudinal joint at center line under main lanes and shoulder. Do not use longitudinal joints under frontage roads and ramps.

F. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Secure a firm bond between reinforcement and base.

3.04 COMPACTION

A. Start compaction as soon as possible but not more than 60 minutes from start of moist mixing. Compact loose mixture with approved tamping rollers until entire depth is uniformly compacted. Do not allow stabilized base to mix with underlying material.

B. Correct irregularities or weak spots immediately by replacing material and recompacting.

C. Apply water to maintain moisture between optimum and 3 percent above optimum moisture as determined by ASTM D1557. Mix in with a spiked tooth harrow or equal. Reshape surface and lightly scarify to loosen imprints made by equipment.

D. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.

E. Finish by blading surface to final grade after compacting final course. Seal with approved pneumatic tired rollers which are sufficiently light to prevent surface hair line cracking. Rework and recompact at areas where hairline cracking develops.

F. Compact to minimum density of 95 percent of modified Proctor density at a moisture content of treated material between optimum and 3 percent above optimum as determined by ASTM D1557, unless otherwise indicated on the Drawings.

G. Maintain surface to required lines and grades throughout operation.

3.05 CURING

A. Moist cure for minimum of 7 days before adding pavement courses. Restrict traffic on base to local property access. Keep subgrade surface damp by sprinkling.

B. If indicated on Drawings, cover base surface with a curing membrane as soon as finishing operation is complete. Apply with approved self-propelled pressure distributer at following rates, or as indicated on Drawings:

1. MC30: 0.1 gallon per square yard.

2. EPR-1 Prime: 0.15 gallon per square yard.

C. Do not use cutback asphalt during the period of April 16 to September 15.

3.06 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top surface of base course: Plus or minus 1/4 inch in cross section, or in 16-foot length.

3.07 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one core will be taken at random locations per 1,000 linear feet per lane of roadway or 1000 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM 3017 at a random location near each depth determination core. Rework and recompact areas that do not conform to compaction requirements at no additional cost to the Owner.

E. Fill cores and density test sections with new compacted cement stabilized base.

3.08 PROTECTION

A. Maintain stabilized base in good condition until completion of work. Repair defects immediately by replacing base to full depth.

B. Protect the asphalt membrane, if used, from being picked up by traffic. The membrane may remain in place when proposed surface courses or other base courses are to be applied.

END OF SECTION

SECTION 02234

RECYCLED CRUSHED CONCRETE BASE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Recycled crushed concrete base (RCCB) course.

1.02 UNIT PRICES

A. Measurement of and payment for RCCB is on a square yard basis for properly installed material. Separate measurement will be made for each different required thickness of base course.

1.03 SYSTEM DESCRIPTION

A. Provide RCCB with following performance:

1. Minimum 5 percent cement.

2. Minimum Compressive Strength: 650 psi at 7 days following TxDOT Tex-120-E.

3. Prepare concrete product in an on- or off-site pug mill, or in an on- or off-site portable concrete mixer.

B. Preliminary Design: Prepare preliminary mix for 4 cement ratios; 5, 6, 7 and 8 percent.

1. Designate source of concrete for crushing. Follow Section 01410- Testing Laboratory Services for tests of concrete from source.

2. Results of compression tests will be used by Engineer to select the final mix design.

1.04 SUBMITTALS

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

B. Submit samples of crushed concrete, gravel, and soil binder for testing.

C. Submit weight tickets, certified by supplier, for each delivery of crushed concrete and cement to mixing site.

D. Submit manufacturer's description and characteristics for pug mill and associated equipment, mixer trucks, spreading machine, and compaction equipment for approval.

1.05 TESTS

A. Follow Section 01410- Testing Laboratory Services.

B. Test and analyze aggregate and binder products following TxDOT Tex-110-E.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Make stockpiles from layers of processed aggregate without 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 PORTLAND CEMENT

A. ASTM C150 Type I, II or III; bulk or sacked.

2.02 WATER

A. Potable.

2.03 AGGREGATE

A. Recycled Crushed Concrete: Material retained on the No. 40 Sieve, and durable coarse particles of crusher-run reclaimed cured Portland cement concrete, obtained from an approved source. Organic material is prohibited.

B. Soil Binder (classified below): Meeting the following requirements when tested following TxDOT Tex-106-E:

1. Maximum Liquid Limit: 35

2. Maximum Plasticity Index: 10

C. Mixed Aggregate and Soil Binder: Grading following Tex-101-E and Tex-110-E within the following limits:

Sieve	Percent Crushed Concrete Retained

1-3/4”	0 to 10
No. 4	45 to 75
No. 40	55 to 80; classified as “Soil Binder”

1. Obtain prior permission from Director for use of additives to meet above requirements.

2.04 ASPHALTIC SEAL CURE

A. Use following as Contractor's option to curing by sprinkling, at no additional cost or time.

B. Cut-back asphalt: MC30 following Section 02511.

C. Emulsified petroleum resin: EPR-1 Prime following Section 02511.

2.05 MATERIAL MIX AND MIXING EQUIPMENT

A. Design mix for minimum compressive strength of 650 psi at 7 days following Tex-120-E unconfined compressive strength.

B. Cement Ratio: Follow Paragraph 1.04 A. Increase cement content in one percent steps up to 8 percent maximum if compressive strength of design mix samples and field samples of installed product fail above test.

C. Mix following Paragraph 1.04 A, with metering devices adding specified quantities of crushed concrete, cement, and water into mixer. Dry mix crushed concrete and cement to prevent cement balls from forming when water is added. Produce homogeneous and uniformly mixed product.

2.06 SOURCE QUALITY CONTROL

A. Test following Section 01410.

B. Designate single source of crushed concrete for work.

C. Test for unconfined compressive strength following Test Method Tex-120-E as follows:

1. Mold 3 samples each day or for each 1,000 tons of production.

2. Compressive Strength: Average of 3 tests for each production lot.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Follow Section 01410- Testing Laboratory Services.

B. Verify buried utility work is complete.

C. Verify subgrade is ready to support imposed loads.

D. Verify flatwork, foundations, projecting reinforcement and similar work interfacing to base is in place.

E. Verify lines and grades are correct.

3.02 PREPARATION

A. Have sufficient products and equipment on hand to expeditiously apply base.

3.03 MIXING

A. Maintain moisture content of mixture between optimum and 10 percent above optimum.

3.04 PLACEMENT

A. Do not mix and place cement stabilized base under following conditions:

1. 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.

2. When precipitation is falling or is forecast to fall before initial set takes place.

B. Place base on prepared subgrade in uniform layers of 8 inches or less to produce thickness indicated on Drawings. Do not dump material in piles or windrows.

C. Place mixture with approved spreading machine. Spread to eliminate planes of weakness or pockets of nonuniformly graded material resulting from hauling and dumping operations.

D. Provide approximately vertical construction joints between fresh base and base in place 4 hours or longer. Form joint with a temporary header or make vertical cut of in-place base immediately before placing fresh base.

E. Make cold joints at centerline of head-to-head parking stalls.

F. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Provide proper bond between reinforcement and base.

3.05 COMPACTION

A. Start compaction maximum 3 hours after start of moist mixing. Compact loose mixture with approved tamping rollers until entire depth is uniformly compacted. Do not allow base to mix with underlying material.

1. Do not rework uncompacted material which has sat for more than 30 minutes.

2. Complete compaction within 6 hours from start of moist mixing.

B. Correct irregularities or weak spots immediately by replacing material and recompacting.

C. Apply water to maintain moisture between optimum and 5 percent above optimum moisture.

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 or flat wheel 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, following TxDOT Tex -114-E, at a moisture content of treated material between optimum and 5 percent above optimum.

G. Maintain surface to required lines and grades throughout operation.

3.06 CURING

A. Moist cure for minimum of 72 hours before adding pavement courses. Prevent construction traffic on base for minimum 3 days, except light vehicles used to maintain proper cure are permitted on base after initial set or as permitted by the Director.

B. Use sprinkling or, at Contractor's option, apply following curing membrane as soon as initial set begins, using approved light-weight self-propelled pressure distributer:

1. MC30: 0.1 gallon per square yard.

2. EPR-1 Prime: 0.15 gallon per square yard.

3.07 TOLERANCES

A. Completed Surface: 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.

3.08 FIELD QUALITY CONTROL

A. Test following 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 Contractor's 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. Perform compaction tests following TxDOT Tex-114-E at a random location near each depth determination core. Rework and recompact areas failing compaction requirements.

E. Fill cores and density test sections with new and properly mixed, placed and compacted base product.

3.09 PROTECTION

A. Maintain base in proper condition until completion of work. Repair defects immediately by replacing base to full depth.

B. Curing membrane may remain in place at areas where surface courses or other base courses are applied.

END OF SECTION

SECTION 02238

HOT MIX ASPHALTIC BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foundation course of compacted a mixture of coarse and fine aggregates, and asphaltic material.

1.02 MEASUREMENT AND PAYMENT

A. Measurement for hot mix asphaltic base is on a square yard basis. Separate measurement will be made for each different required thickness of base course. All load tickets shall be submitted before payment is processed.

B. Measurement for asphaltic skim patching is on a square yard basis. All load tickets shall be submitted before payment is processed.

C. Refer to Section 01025 - Measurement and Payment for unit price procedures.

D. Refer to paragraph 3.10 for unit price adjustments.

1.03 SUBMITTALS

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

B. Submit certificates that asphaltic materials and aggregates meet requirements of paragraph 2.01.

C. Submit proposed design mix and test data for each type and strength of base course in Work.

D. Submit manufacturer’s description and characteristics of mixing plant for approval.

E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

PART 2 PRODUCTS

2.01 MATERIALS

A. Coarse Aggregate: Gravel or crushed stone, or combination thereof that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic, or other injurious matter occurring either free or as coating on aggregate. Aggregate shall conform to ASTM C33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C131.

B. Fine Aggregate: Sand or stone screenings, or combination thereof, passing No. 10 sieve. Aggregate shall conform to ASTM C33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by Tex-106-E. Sand equivalent shall have a minimum value of 45 when tested by Tex-203-F.

C. Composite Aggregate: Conform to the grading limits of TxDOT Item 340 for the paving type indicated on the Drawings.

D. Asphaltic Material: Moisture-free homogeneous material which will not foam when heated to 347 degrees F, meeting the following requirements:

VISCOSITY GRADE				
TEST	**AC-10**		**AC-20**	
	MIN	**MAX**	**MIN**	**MAX**
Viscosity, 140°F stokes	1000	1200	2000	-
Viscosity, 275°F stokes	1.9	-	2.5	-
Penetration, 77°F, 100 g, 5 sec.	85	-	55	-
Flash Point, C.E.C., F.	450	-	450	-
Solubility in trichloroethylene, percent	99.0	-	99.0	-
Tests on residues from thin film oven tests:				
Viscosity, 140°F stokes	-	3000	-	6000
Ductility, 77°F, 5 cms per min., cms	100	-		
Spot tests	Negative for all grades			

1. Material shall not be cracked.
2. Owner's Representative will designate grade of asphalt to use after design tests have been made. Use only one grade of asphalt after grade is determined by test design for project.

2.02 EQUIPMENT

A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuously mixtures meeting specifications. Plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.

1. Cold aggregate bins and proportioning device
2. Dryer
3. Screens
4. Aggregate weight box and batching scales
5. Mixer
6. Asphalt storage and heating devices
7. Asphalt measuring devices
8. Truck scales

B. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix.

2.03 MIXES

A. Employ and pay certified testing laboratory to prepare design mixes. Test in accordance with Tex-126-E, Tex-204-F, Tex-208-F, and Tex-227-F.

B. Density and Stability Requirements:

Percent Density		Percent	HVEEM Stability Percent
Min	Max	Optimum	Not Less Than
95	99	97	35

C. Proportions for Asphaltic Material: As specified in TxDOT Item 340 for the mix type shown on the Drawings.

PART 3 EXECUTION

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 Section 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 PRIME COAT

A. Conform to requirements of Section 02511.

3.04 TACK COAT

A. Conform to requirements of Section 02512.

3.05 PLACEMENT

A. Do not place asphaltic base when air temperature is below 50 degrees F and falling. Base may be placed when air temperature taken in shade and away from artificial heat is above 40 degrees F and rising.

B. Haul prepared and heated asphaltic concrete mixture to project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.

C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type. Use track-mounted finish machine to place base course directly on earth subgrade.

D. Place base courses 4 inches or greater in thickness in two or more layers, each having compacted thickness of not greater than 4 inches. Spread all lifts. Attain smooth course of uniform density to section, line and grades as indicated on Drawings.

E. Place courses as nearly continuously as possible. Pass roller over unprotected ends of freshly laid mixture only when mixture has become cooled. When work is resumed, cut back laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.

F. When new asphalt is laid against existing asphalt, existing asphalt shall be saw cut full depth to provide straight smooth joint. Clean joint and apply tack coat before placement.

G. In restricted areas where use of paver is impractical, spread and finish asphalt by mechanical compactor. Use wood or steel forms, rigidly supported to assure correct grade and cross section. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove any lumps that do not break down readily. Place asphalt courses in same sequence as if placed by machine.

3.06 COMPACTION

A. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hair cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water.

B. Compress surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing from 8 to 10 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and all rolling marks are eliminated. Complete all rolling before mixture temperature drops below 175 degrees F.

C. Along walls, curbs, headers and similar structures, and in all locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.

D. Compact base course to density not less than 92 percent of maximum possible density of void less mixture composed of same materials in like proportions.

3.07 TOLERANCES

A. Furnish templates for checking surface of finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.

B. Completed surface, when tested with 10-foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct any surface not meeting this requirement.

3.08 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Minimum of one core will be taken at random locations per 1000 feet per lane of roadway or 1000 square yards of base to determine in-place depth and density.

C. In-place density will be determined in accordance with Tex-207-F and Tex-227-F from cores or sections of asphaltic base located near each core. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by the Owner's Representative.

D. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths to determine limits of nonconformity.

E. Fill cores and density test sections with new compacted asphaltic base.

3.09 NONCONFORMING PAVEMENT

A. Recompact pavement sections not meeting specified densities or replace them with new asphaltic concrete material. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute.

B. Remove and replace areas of asphaltic base found deficient in thickness by more than 10 percent. Use new asphaltic base of thickness shown on Drawings.

C. Nonconforming pavement sections shall be replaced at no additional cost to Owner.

3.10 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 determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to lower limit of 90 percent of unit price bid.

3. Average depth below 90 percent may be rejected by the Owner's Representative.

3.11 PROTECTION

A. Do not open base to traffic until 12 hours after completion of rolling, or as shown on Drawings.

B. Maintain asphalt base in good condition until completion of Work.

C. Repair defects immediately by replacing base to full depth.

END OF SECTION

SECTION 02241

LIME STABILIZED SUBGRADE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Foundation course of lime stabilized natural subgrade material.

1.02 UNIT PRICES

A. Measurement for Lime Stabilized Subgrade is on a square yard basis. Separate measurement will be made for each different required thickness of stabilized subgrade.

1.03 SUBMITTALS

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

B. Submit certificates stating that hydrated lime, quicklime, or commercial lime slurry complies with these specifications.

C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.

D. Submit manufacturer's description and characteristics for rotary speed mixer and compaction equipment for approval.

1.04 TESTS

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.

C. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.

D. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.

E. Soil will be evaluated to establish percent of hydrated lime, quicklime, or lime slurry to be applied to subgrade material.

F. Moisture-density relationship will be established on material sample from roadway, after stabilization with lime, in accordance with ASTM D698.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Bagged lime shall bear manufacturer's name, product identification, and certified weight. Bags varying more than 5 percent of certified weight may be rejected; average weight of 50 random bags in each shipment shall not be less than certified weight.

B. Store lime in weatherproof enclosures. Protect lime from ground dampness.

C. Quicklime can be dangerous; exercise extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

PART 2 P R O D U C T S

2.01 WATER

A. Water shall be clean; clear; and free from oil, acids, alkali, or organic matter.

2.02 LIME

A. Type A - Hydrated lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide and magnesium hydroxide.

B. Type B - Commercial lime slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.

C. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:

1. Grade DS: Pebble quicklime of a gradation suitable for use in the preparation of a slurry for wet placing.

2. Grade S: Finely-graded quicklime for use in the preparation of a slurry for wet placing. Do not use grade S quicklime for dry placing.

D. Lime shall conform to following requirements:

CHEMICAL COMPOSITION	TYPE		
	A	B	C
Active lime content, % by weight $Ca(OH)_2$+CaO	90.0 min[1]	87.0 min[2]	-
Unhydrated lime content, % by weight CaO	5.0 max	-	87.0 min
Free water content, % by weight H_2O:	5.0 max	-	-
SIZING			
Wet Sieve, as % by weight residue retained:			
No. 6	0.2 max	0.2 max[2]	8.0 max[3]
No. 30	4.0 max	4.0 max[2]	-
Dry sieve, as % by weight residue retained:			
1 – inch	-	-	0.0
3/4-inch	-	-	10.0 max

Notes:

1. Maximum 5.0% by weight CaO shall be allowed in determining total active lime content.
2. Maximum solids content of slurry.
3. Total active lime content, as CaO, in material retained on the No. 6 sieve shall not exceed 2.0% by weight of original Type C lime.

E. Lime slurry may be delivered to the job site as commercial lime, or may be prepared at the job site by using hydrated lime or quicklime. The slurry shall be free of liquids

other than water and shall be of a consistency that can be handled and uniformly applied without difficulty.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted subgrade is ready to support imposed loads.

B. Verify subgrade lines and grades are correct.

3.02 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Cut material to bottom of subgrade using an approved cutting and pulverizing machine meeting following requirements:

1. Cutters accurately provide a smooth surface over entire width of cut to plane of secondary grade.

2. Visible indication that cut is to proper depth.

C. Alternatively, scarify or excavate to bottom of stabilized subgrade. Remove material or windrow to expose secondary grade. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting. Obtain uniform stability.

D. Proof roll subgrade prior to lime application.

3.03 LIME SLURRY APPLICATION

A. Mix hydrated lime or quicklime with water to form a slurry of the solids content specified. Commercial lime slurry shall have dry solids content as specified. Conform to cautionary requirements of Paragraph 1.05C concerning use of quicklime.

B. Apply slurry with a distributer truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on the same working day.

C. Apply so that dry subgrade will contain a minimum lime content of 5 percent by weight of dry subgrade unless otherwise instructed by Testing Laboratory.

3.04 PRELIMINARY MIXING

A. Do not mix and place material when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.

B. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.

C. Shape mixed subgrade to final lines and grades.

D. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.05C can be met during preliminary mixing:

1. Seal subgrade as a precaution against heavy rainfall by rolling lightly with light pneumatic rollers.

2. Cure soil-lime material for 3 days minimum. Keep subgrade moist during cure.

3.05 FINAL MIXING

A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.

B. Add water to bring moisture content of soil mixture to a minimum of optimum or above.

C. Mix and pulverize until all material passes a 1-3/4-inch sieve; a minimum of 85 percent, excluding nonslacking fractions, passes a 3/4-inch sieve; and a minimum of 60 percent excluding nonslacking fractions passes a No. 4 sieve.

D. Shape mixed subgrade to final lines and grades.

E. Do not expose hydrated lime to open air for 6 hours or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

3.06 COMPACTION

A. Aerate or sprinkle to attain optimum moisture content as determined by Testing Laboratory. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.

B. Start compaction immediately after final mixing, unless approved by Owner's Representative.

C. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches.

D. Compact with approved heavy pneumatic or vibrating rollers, or a combination of tamping rollers and light pneumatic rollers. Begin compaction at the bottom and continue until entire depth is uniformly compacted.

E. Do not allow stabilized base to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.

F. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:

1. Areas to receive pavement without subsequent base course: Minimum density of 98 percent of maximum dry density.

2. Areas to receive subsequent base course: Minimum density of 95 percent of maximum dry density.

G. Seal with approved light pneumatic tired rollers: Prevent surface hair line cracking. Rework and recompact at areas where hairline cracking develops.

3.07 CURING

A. Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. Time may be adjusted as approved by Owner's Representative. Subgrade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

B. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

C. Place base, surface, or seal course within 14 days after final mixing and compaction unless prior approval is obtained from Owner's Representative.

3.08 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16-foot length.

3.09 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. A minimum of one phenolphthalein test will be made at random locations per 1000 linear feet per lane of roadway or 1000 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017 at a random location near depth determination tests. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.

E. Fill test sections with new compacted lime stabilized subgrade.

3.10 PROTECTION

A. Maintain stabilized subgrade to lines and grades and in good condition until placement of base or surface course. Protect the asphalt membrane, if used, from being picked up by traffic.

B. Repair defects immediately by replacing material to full depth.

END OF SECTION

SECTION 02249

GEOTEXTILE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Geotextile fabric, also called filter fabric, in applications such as a pipe embedment wrap, around the exterior of a tunnel liner, or around the foundations of pipeline structures and slope stabilization.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this Section. Include the cost of such work in unit prices for work requiring geotextile, such as pipe embedment, sewer line in tunnel, or placement of manhole foundations, as appropriate.

1.03 SUBMITTALS

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

B. Submit the standard manufacturer's catalog sheets and other pertinent information, for approval, prior to installation.

C. Submit installation methods, as a part of the work plan for tunneling or for excavation and backfill for utilities. Obtain approval from Owner’s Representative for geotextile material and the proposed installation method prior to use of the geotextile.

PART 2 P R O D U C T S

2.01 GEOTEXTILE

A. Provide a geotextile (filter fabric) designed for use in geotechnical applications which forms a permeable layer or media while retaining the soil matrix.

B. Use a fabric which meets the physical requirements for Class A Subsurface Drainage installation conditions as defined in AASHTO M288 and as specified in paragraph 2.02.

2.02 PROPERTIES

A. Material: Nonwoven, nonbiodegradable, fabric consisting only of continuous chain polymer filaments or yarns, at least 85 percent by weight polyolefins, polyesters or polyamide, formed into a dimensionally stable network.

B. Chemical Resistance: Inert to commonly encountered chemicals and hydrocarbons over a pH range of 3 to 12.

C. Physical Resistance: Resistant to mildew and rot, ultraviolet light exposure, insects and rodents.

D. Minimum Test Values:

Property	Value (Min.)	Test Method
Grab Strength	180 lbs.	ASTM D 4632
Trapezoidal Tear Strength	50 lbs.	ASTM D 4533
Puncture Strength	80 lbs.	ASTM D 4833
Mullen Burst Strength	290 psi.	ASTM D 3786
Apparent Opening Size[(1)]	0.25 mm	ASTM D 4751
Permittivity (sec^{-1})	0.2	ASTM D 4491

[(1)]Maximum average roll value

PART 3 E X E C U T I O N

3.01 LINE WORK

A. Use geotextile with backfill for utilities in conformance with Section 02227 - Excavation and Backfill for Utilities.

3.02 TUNNEL WORK

A. Use geotextile outside of a tunnel primary liner to prevent the migration of soil fines into the excavated tunnel resulting in voids or settlement. Conform to Section 02310 - Tunnel Excavation and Primary Liner. Select a geotextile, subject to the minimum requirements of Paragraph 2.02, meeting tunnel liner design requirements and installation conditions.

END OF SECTION

SECTION 02252

CEMENT STABILIZED SAND

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cement stabilized sand for backfill and bedding.

1.02 UNIT PRICES

A. No payment will be made for cement stabilized sand under this Section unless an extra unit price item is included in the Bid Proposal and the application of the pay item is approved by the Owner's Representative. Include payment for cement stabilized sand in unit price for applicable bid items.

B. If use of cement stabilized sand is allowed based on the Owner's Representative's direction the extra unit price item will be paid on a per ton basis. A conversion between volume calculated based on theoretical limits and total weight will be made based on a ratio of 1.64 tons per cubic yard.

1.03 SUBMITTALS

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

B. Submit material qualification and mix design tests to include:

1. Three series of tests of sand or fine aggregate material from the proposed source. Tests shall include procedures defined in Paragraph 2.01.

2. Three moisture-density relationship tests prepared using the material qualified by the tests of Paragraph 1.03B.1. Blends of fine aggregate from crushed concrete and bank run sand shall be tested at the ratio to be used for the mix design testing.

3. Mix design report to meet the design requirements of Paragraph 1.04. The mix design shall include compressive strength tests after 48-hours and 7 days curing.

C. Submit stamped load tickets with time of loading directly after mixing.

1.04 DESIGN REQUIREMENTS

A. Design sand-cement mixture to produce a minimum unconfined compressive strength of 100 pounds per square inch in 48 hours when compacted to 95 percent in accordance with ASTM D558 and when cured in accordance with ASTM D1632, and tested in accordance with ASTM D1633. Mix for general use shall contain a minimum of 1-1/2 sacks of cement per cubic yard. Mix for use as sanitary sewer embedment within 9 feet of waterlines shall contain 2 sacks of cement per cubic yard. Compact mix with a moisture content on the dry side of optimum.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Cement: Type 1 Portland cement conforming to ASTM C150.

B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C33, or requirements for Bank Run Sand of Section 02229 - Utility Backfill Materials, and the following requirements:

1. Classified as SW, SP or SM by the United Soil Classification System of ASTM D2487.

2. Deleterious materials:

a. Clay lumps, ASTM C142; less than 0.5 percent.

b. Lightweight pieces, ASTM C123; less than 5.0 percent.

c. Organic impurities, ASTM C40; color no darker than the standard color.

3. Plasticity index of 4 or less when tested in accordance with ASTM D4318.

C. Fine aggregate manufactured from crushed concrete meeting the quality requirements for crushed rock material of Section 02229 - Utility Backfill Materials, may be used as a complete or partial substitute for bank run sand. The blending ratio of fine aggregate from crushed concrete and bank run sand shall be defined in the mix design report.

D. Water: Potable water, free of oils, acids, alkalis, organic matter or other deleterious substances, meeting requirements of ASTM C94.

2.02 MIXING MATERIALS

A. Thoroughly mix sand, cement and water in proportions of the mix design using a pugmill-type mixer. The plant shall be equipped with automatic weight controls to ensure correct mix proportions.

B. Stamp batch ticket at plant with time of loading directly after mixing. Material not placed and compacted within 4 hours after mixing shall be rejected.

C. No hand mixing is allowed on site.

PART 3 E X E C U T I O N

3.01 PLACING

A. Place sand-cement mixture in 8-inch-thick loose lifts and compact to 95 percent of ASTM D558, unless otherwise specified. The moisture content during compaction shall be on the dry side of optimum but sufficient for hydration. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at the plant.

B. Do not place or compact sand-cement mixture in standing or free water.

3.02 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabilized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 lb each from the first, middle, and last third of the truck and composite them into one sample for test purpose.

C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.

D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.

E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.

F. A strength test will be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.

G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D 1633 Section 9.

H. Reporting: Test reports shall contain, as a minimum, the following information:
1. Supplier and plant number
2. Time material was batched
3. Time material was sampled
4. Test age (exact hours)
5. Average 48-hour strength
6. Average 7-day strength
7. Specification section number
8. Indication of compliance / non-compliance
9. Mixture identification
10. Truck and ticket numbers
11. The time of molding
12. Moisture content at time of molding
13. Required strength
14. Test method designations
15. Compressive strength data as required by ASTM D 1633
16. Supplier mixture identification
17. Specimen diameter and height, in.
18. Specimen cross-sectional area, sq. in.

3.03 ACCEPTANCE

A. Strength level of material will be considered satisfactory if:
1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.

2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.

B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.04 Adjustment for Deficient Strength.

C. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.

D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which

exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.
Testing laboratory shall notify Contractor, Project Manager, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.

E. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03.A.

F. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less that 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.04 ADJUSTMENT FOR DEFICIENT STRENGTH

A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.

B. When mixture produces 7-day compressive strength less than 100 psi and greater than or equal to 70 psi, material shall be accepted contingent on credit in payment. Compute credit by the following formula:

$$\text{Credit per Cubic Yard} = \frac{\$30.00 \times 2\,(100 \text{ psi} - \text{actual psi})}{100}$$

C. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to City.

END OF SECTION

SECTION 02317

AUGERING PIPE FOR WATER LINES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installing water service pipe by methods of auguring.

1.02 UNIT PRICES

A. Augered pipe will be measured along the axis of the pipe and shall include fittings. In the case of a branch pipe, the length of the pipe will be considered as the distance from the axis of the line to the end of the branch. The length of the pipe laid between two lines or from a line to an appurtenance will be measured between the centerlines of each.

B. Auger pits and other excavations are incidental to the work. Trench Safety for Auger Pits and other excavations for work specifically performed for this section shall be included in Section 01526 - Trench Safety.

C. No separate payment will be made for pavement removal and replacement (i.e., lime stabilization, crushed limestone, hot mix asphalt surface course, cement sand base, and concrete pavement, etc.) associated with augering.

D. If open-cut construction is requested by Contractor for his convenience in areas designated for augering, and if approved in advance by the Owner's Representative, such areas shall be paid for at the Contract Unit Price for open cut construction. Payment includes necessary surface restoration and pavement repair.

1.03 SUBMITTALS

A. Submit product data in accordance with requirements of all sections and provisions of these specifications.

B. Submit product data for casing insulators for approval.

C. Prior to commencement of work, furnish for the Owner's Representative's approval, a plan showing pit locations. Approval of this plan will not relieve Contractor from responsibility to obtain specified results.

D. Show actual pit locations dimensioned on as-built drawings so that they can be identified in field.

1.04 REGULATORY REQUIREMENTS

A. Conform to Texas Department of Transportation for installations under state highways.

B. Installations under railroads:

1. Secure and comply with requirements of right-of-entry for crossing railroad company's easement or right-of-way from railroad companies affected. Comply with railroad permit requirements. Submit copy to the Owner's Representative.

2. Use dry auger method only.

3. No extra compensation for damages due to delays caused by the railroad requesting work to be done at hours which will not inconvenience the railroad.

4. Maintain minimum 35-foot clearance for bore pits from centerline of tracks, unless approved by railroad company and Owner.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Piping and Fittings: As required by Drawings.

B. Casings: Where required by Drawings, in accordance with Section 02611 - Steel Pipe and Fittings.

C. Insulators: Where casings are required by Drawings, casing insulator width 8 inches for pipe sizes 4 to 12 inches; 12 inches for pipe sizes 14 to 30 inches or as shown on drawings.

D. Casing End Seals: Provide Pipeline Seal & Insulator Model C or approved equal.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Do not exceed 100 feet for length of auger hole for PVC pipe less than 12 inches in diameter without intermediate pit, unless shown otherwise on the drawings.

B. Do not exceed 75 feet for length of auger hole for PVC pipe 12 inches to 16 inches in diameter without intermediate pit, unless shown otherwise on the drawings.

C. Do not exceed 40 feet for length of auger hole for PVC pipe greater than 16-inches in diameter without intermediate pit, unless shown otherwise on the drawings.

3.02 PREPARATION

A. Conform to applicable provisions of Section 02100 - Right-of-Way Preparation.

3.03 TRAFFIC CONTROL

A. Conform to applicable provisions of Section 01570 - Traffic Regulation and Control.

B. Secure right-of-entry for crossing railroad company's easement or right-of-way.

3.04 JACKING

A. Comply with Section 01526 - Trench Safety Systems for all pits, access shafts, end trenches and other excavations relating to work required by this specification.

B. If grade of pipe at jacking end is below ground surface, excavate suitable pits or trenches for conducting jacking operations and for placing end joints of pipe. Wherever end trenches are cut in sides of embankment or beyond it, sheath securely and brace such work to prevent earth caving.

C. No more than one joint shall be made-up in pit or trench prior to jacking.

D. Construction shall not interfere with operation of railroad, street, highway, or other facility, nor weaken or damage embankment or structure.

E. During construction operations, furnish and maintain barricades and lights to safeguard traffic and pedestrians as directed by the Owner’s Representative, until such time as backfill has been completed and removed from site.

F. Provide heavy-duty jacks suitable for forcing pipe through embankment. Use suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head and suitable jacking frame or backstop so that jacking pressure will be applied to pipe uniformly around ring of pipe. Set pipe to be jacked on guides, properly braced together, to support section of pipe and to direct it in proper line and grade. Place jacking assembly in line with direction and grade of pipe. Excavate embankment material just ahead of pipe and remove material through pipe. Force pipe through embankment with jacks, into space thus provided.

G. Conform excavation for underside of pipe to contour and grade of pipe, for at least one third of circumference of pipe. Provide clearance of not more than 2 inches for upper half of pipe. Taper off upper clearance to zero at point where excavation conforms to contour of pipe.

H. Distance that excavation shall extend beyond end of pipe depends on character of material, but it shall not exceed 2 feet in any case. Decrease distance on instructions from the Owner's Representative, if character of material being excavated makes it desirable to keep advance excavation closer to end of pipe.

I. Jack pipe from low or downstream end. Lateral or vertical variation in final position of pipe from line and grade established by the Owner's Representative will be permitted only to extent of 1 inch in 10 feet, provided such variation is regular and only in one direction and that final grade of flow line is in direction indicated on plans.

J. Use cutting edge of steel plate around head end of pipe extending short distance beyond end of pipe with inside angles or lugs to keep cutting edge from slipping back onto pipe.

K. Once jacking of pipe is begun, carry on without interruption, insofar as practicable, to prevent pipe from becoming firmly set in embankment.

L. Remove and replace any pipe damaged in jacking operations.

M. Backfill pits or trenches excavated to facilitate jacking operations immediately after completion of jacking of pipe.

N. Grout annular space when loss of embankment occurs or when clearance of two inches is exceeded.

3.05 AUGURING (BORING)

A. Auger from approved pit locations. Excavate for pits and install shoring as outlined above under "Jacking." Auger mechanically with use of a pilot hole entire length of crossing and check for line and grade on opposite end of bore from work pit. The large hole is to be no more than 2 inches larger than diameter of bell. Place excavated material outside working pit and dispose of as required. Use water or other fluids in connection with boring operation only to lubricate cuttings; jetting will not be permitted.

B. In unconsolidated soil formations, a gel-forming colloidal drilling fluid may be used. Fluid is to consist of at least 10 percent of high-grade processed bentonite and shall consolidate cuttings of bit, seal walls of hole, and shall furnish lubrication for subsequent removal of cuttings and installation of pipe.

C. Grout annular space when loss of embankment occurs or when clearance of two inches is exceeded.

3.06 CASING

A. Install casings as required by Drawings, in accordance with this section.

3.07 INSULATOR INSTALLATION

A. There must be no inadvertent metallic contact between casing and carrier pipe. Spacing of spacers should ensure that carrier pipe is adequately supported throughout its length, particularly at ends, to offset settling and possible electrical shorting. End spacer must be within 6 inches of end of casing pipe, regardless of size of casing and carrier pipe or type of spacer used. Casing spacers are designed to withstand much greater loads than can be safely applied to most coatings. Therefore, spacing between spacers depends largely on load bearing capabilities of pipe coating and flexibility of pipe.

B. Bottom of trench adjacent to each end of casing should be graded to provide firm, uniform and continuous support for carrier pipe. If trench requires some backfill to establish final trench bottom grade, backfill material should be placed in 6-inch lifts and each layer properly compacted.

C. Casing spacers should be installed in accordance with manufacturer's instructions. Special care should be taken to ensure that all subcomponents are correctly assembled and evenly tightened, and that no damage occurs during tightening of insulators or carrier pipe insertion.

D. Annulus between carrier pipe and casing should be sealed with casing end seals at each end of casing.

E. Insulator Spacing:

1. Spacing shall be as shown on Drawing with maximum distance between spacers to be 10 feet for pipe sizes 4 to 14 inches and 6 feet for pipe sizes 16 to 30 inches.

2. If casing or carrier pipe is angled, bent or dented, spacing should be reduced.

3.08 PITS

A. Locate auger pits where there is minimum interference with traffic or access to property.

B. Pit Size: Provide minimum 6-inch space between pipe and walls of bore pit. Maximum allowable width of pit shall be 5 feet unless approved by the Owner’s Representative. Width of pit at surface shall not be less than at bottom. Maximum allowable length of pit shall be no more than 5 feet longer than one full joint of pipe and shall not exceed 25 feet unless approved by the Owner’s Representative.

C. Excavate bore pits to finished grade at least 6 inches lower than grade indicated by stakes or as approved by the Owner's Representative.

D. Backfill in accordance with Section 02227.

3.09 CLEANUP

A. Conform to applicable provisions of Section 01564 - Waste Material Disposal.

3.10 FILLING ANNULAR SPACE

A. Allowable variation from line and grade shall be as specified under "Jacking." Block void space around pipe in augered hole with approximately 12 inches of packed clay or similar material approved by the Owner's Representative, to prevent bedding or backfill from entering the void around the pipe in the augered hole when compacted. For pipe diameters 4 inches through 8 inches use minimum 1/2 cubic foot clay for pipe diameters 12 inches through 16 inches use minimum 3/4 cubic foot clay.

END OF SECTION

SECTION 02330

TUNNEL GROUT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Mix design requirements, testing, furnishing and production of grout for:

1. Pressure grouting of bolted liner plates for shafts.
2. Pressure grouting of primary tunnel liner.
3. Pressure grouting of jacked-pipe.
4. Annular grouting of cased or uncased sewer pipe.
5. Grouting of the annular space between the sanitary sewer pipe and the primary tunnel liner.
6. Grouting voids in ground resulting from caving, loss of ground, or settlement.
7. Grouting of manholes constructed in shafts.

B. Compaction grouting is not part of this specification.

1.02 UNIT PRICE

A. No separate payment will be made for work performed under this Section. Include the cost of such work in contract unit prices for work of which it is a component part.

1.03 DEFINITIONS

A. Pressure Grouting. Filling a void behind a liner or pipe with grout under pressure sufficient to ensure void is properly filled but without overstressing temporary or permanent ground support, or causing ground heave to occur.

B. Back Grouting. Secondary pressure grouting to ensure that voids have been filled between primary tunnel or shaft liners and the surrounding ground.

C. Annular Grouting. Filling the annular space between the carrier pipe and the primary tunnel liner, casing, or ground, by pumping.

D. Ground Stabilization Grouting. The filling of voids, fissures, or under-slab settlement due to caving or loss of ground by injecting grout under gravity or pressure to fill the void.

1.04 SUBMITTALS

A. Make submittals in accordance with all provisions and sections of these specifications.

B. Submit a description of materials, grout mix, equipment and operational procedures to accomplish each grouting operation. The description may include sketches as appropriate, indicating type and location of mixing equipment, pumps, injection points, venting method, flowlines, pressure measurement, volume measurement, grouting sequence, schedule, and stage volumes.

C. Submit a grout mix design report, including:

1. Grout type and designation.

2. Grout mix constituents and proportions, including materials by weight and volume.

3. Grout densities and viscosities, including wet density at point of placement.

4. Initial set time of grout.

5. Bleeding, shrinkage/expansion.

6. Compressive strength.

D. For cellular grout, also submit the following:

1. Foam concentrate supplier's certification of the dilution ratio for the foam concentrate.

2. A description of the proposed cellular grout production procedures.

E. Maintain and submit logs of grouting operations indicating pressure, density, and volume for each grout placement.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Grouting materials: Conform to Section 03305 - Concrete for Utility Construction, except as modified in the following paragraphs.

B. Grout Type Applications.

1. Grout for pressure grouting and back grouting: Sand-cement mortar mix.

2. Grout for annular grouting: Low density (cellular) grout or sand-cement mortar mix.

3. Grout for filling space around manholes in shafts: Sand-cement mortar mix.

4. Ground stabilization: Sand cement mortar mix.

5. Do not include toxic or poisonous substances in the grout mix or otherwise inject such substances underground.

2.02 GROUT

A. Employ and pay for a commercial testing laboratory, acceptable to the Owner's Representative, to prepare and test the grout mix design. Develop one or more mixes based on the following criteria as applicable:

1. Size of the annular void between sewer pipe and liner, or size of the void between primary liner and the surrounding soil.

2. Absence or presence of groundwater.

3. Adequate retardation.

4. Non-shrink characteristics.

5. Pumping distances.

B. Prepare mixes that satisfy the required application. Materials used in grout mix shall meet the following standards:

1. Cement: ASTM C150.

2. Fly Ash: ASTM C618.

3. Water: Potable.

4. Foam: ASTM C869.

5. Slurry: ASTM C138.

6. Cellular Grout: ASTM C138.

7. Sand for sand-cement mortar mix: ASTM C144.

C. Provide grout that meets the following minimum requirements:

1. Minimum 28 day unconfined compressive strength: 1,000 psi for sand-cement mortar grout; 300 psi for cellular grout.

2. Determine strength by ASTM C942.

D. Fluidifier. Use a fluidifier, meeting ASTM C937, which holds the solid constituents of the grout in colloidal suspension and is compatible with the cement and water used in the grouting operations.

E. Admixtures.

1. Use admixtures meeting ASTM C494 and ASTM C1017 as required, to improve pumpability, to control time of set, to hold sand in suspension and to reduce segregation and bleeding.

2. For cellular grout, do not use foam or admixtures that promote steel corrosion.

3. Ensure that admixtures used in a mix are compatible. Provide written confirmation from the admixtures' manufacturers of their compatibility.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Notify the Owner's Representative at least 24 hours in advance of grouting operations.

B. Select and operate grouting equipment to avoid damage to new or existing underground utilities and structures.

C. In selection of grouting placement consider pipe flotation, length of pipe, length of tunnel, depth from surface, type of sewer pipe, type of pipe blocking and bulkheading, grout volume and length of pipe to be grouted between bulkheads.

D. Operate any dewatering systems until the grouting operations are complete.

3.02 EQUIPMENT

A. Batch and mix grout in equipment of sufficient size and capacity to provide the necessary quality and quantity of grout for each placement stage.

B. Use equipment for grouting of a type and size generally used for the work, capable of mixing grout to a homogeneous consistency, and providing means of accurately measuring grout component quantities and accurately measuring pumping pressures. Use pressure grout equipment which delivers grout to the injection point at a steady pressure.

3.03 PRESSURE GROUTING FOR PRIMARY TUNNEL AND SHAFT LINER

A. Perform grouting operations to fill voids outside of the primary tunnel or shaft liner.

B. For nonexpendable primary liners installed behind a shield or tunnel boring machine (TBM), fill voids with sand-cement grout promptly after each ring of the liner is out of the shield. Keep the grout pressure below a value that may cause damage or distortion to the installed liner plate rings. Provide seals on the tail of the shield or TBM which will prevent grout from spilling.

C. For nonexpendable primary liners installed by hand mining or in shafts, grout once every 4 feet or more frequently if conditions dictate.

D. Control grout pressures so that tunnel or shaft liner is not overstressed, and ground heave is avoided.

E. For liner requiring grout, perform back grouting once each shift, or more often if required to ensure that all voids are filled.

3.04 ANNULAR GROUTING FOR SEWER LINE IN TUNNELS AND IN CASED OR UNCASED AUGERS

A. Fill the annular space between the sewer pipe and the tunnel primary liner, casing or ground, with grout.

B. Placement

1. Placement Limits: The limits of each grout placement stage shall be predetermined by the size and capacity of the batching equipment and the initial set time of the proposed grout. Under no circumstances shall placement continue at a grout port longer than that period of time for the mix to take initial set. Grout hole spacing and locations shall be located according to the number of stages necessary to grout tunnel liners. A stage or lift cannot be installed on another lift until a proper set has been attained. Have placement procedures approved by the admixture or additive manufacturer.

2. Limit pressure on the annular space to prevent damage or distortion to the pipe or liner. Define the limiting and estimated required pressure range.

Provide an open ended, high point tap or equivalent vent and monitor it at the bulkhead opposite to the point of grouting.

3. Pump grout until a material discharging is similar in consistency to that at point of injection.

4. In a primary lined tunnel, limit length of pipe installed to 200 feet or less before grouting the same length of sewer line. Repeat this cycle until all pipe is installed and grouted.

C. Remove temporary bulkheads installed for grouting.

D. Batch and mix cellular grout mechanically to ensure consistency of the mix. Wet solids thoroughly before introduction of the foaming agent. Operate the batching system to maintain slurry weight within 3 percent of design density. Introduce foam into slurry in accordance with the manufacturer's recommendations.

3.05 PRESSURE GROUTING FOR JACKED PIPE

A. For jacked pipe 60 inches in diameter or greater, pressure grout the annulus after installation, displacing the bentonite lubrication. Jacked pipes less than 60-inch diameter may be left ungrouted unless the excavated diameter exceeds the external pipe diameter by more than one inch.

B. Inject grout through grout holes in the sewer pipe. Drilling holes from the surface or through the carrier pipe walls is not allowed. Perform grouting by injecting it at the pipe invert with bentonite displacement occurring through a high point tap or vent.

C. Control ground water as necessary to permit completion of grouting without separation of the grout materials.

D. Limit pressures to prevent damage or distortion to the pipe or to keep flexible pipe within acceptable tolerances.

E. Pump grout until material discharging is similar in consistency to that at point of injection.

3.06 GROUND STABILIZATION GROUTING

A. Completely fill voids outside the limits of excavation caused by caving or collapse of ground. Fill with gravity or pressure injected sand-cement grout as necessary to fill the void.

B. Take care in grouting operations to prevent damage to adjacent utilities or public or private property. Grout at a pressure that will not distort or damage any portion of the work or existing installations or structures.

C. Verify that the void has been filled by volumetric comparisons and visual inspection. In the case of settlement under existing slabs, take cores as directed by the Owner's Representative, at no additional cost to the Owner, to demonstrate that the void has been filled.

3.07 QUALITY CONTROL

A. Pressure Grouting for Primary Tunnel and Shaft Liners

1. For each shaft, make one set of four compressive test specimens for each 30-foot depth and one set for any remaining portion less than a 30-foot increment.

2. Make one set of four compressive test specimens for every 200 feet of primary lined, (non-expandable) tunnel requiring grout.

B. Annular Grouting for Sewer Line in Tunnels and in Cased or Uncased Augers.

1. Make one set of four compressive test specimens for every 200 feet of sewer pipe installed in primary lined tunnel.

2. For cased or uncased augers, make one set of four compressive test specimens for each grouting operation, or for each 100 feet of pipe installed, whichever is more frequent.

3. For cellular grout, check the slurry density both at point of batching and placement at least twice each hour in accordance with ASTM C138. Record density, time, and temperature. Density must be within 3 percent of design density at point of batching and 5 percent of design density at point of placement.

C. Pressure Grouting for Jacked Pipe. Make one set of four compressive test specimens for every 400 feet of jacked pipe pressure grouting.

D. Ground Stabilization Grouting.

1. Make one set of four compressive test specimens for every location where ground stabilization grouting is performed.

END OF SECTION

SECTION 02331

SLIPLINING GROUT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This Section specifies the furnishing and placing of grout in the annular space between the slipliner pipe and the host sewer.

1.02 UNIT PRICES

A. No separate payment will be made for Work performed under this Section. Include the cost of such Work in contract unit prices for sliplining sanitary sewers.

1.03 SUBMITTALS

A. At least 30 days prior to grouting, submit details of equipment, grout mixes, and procedures in accordance with all sections and provisions of these specifications. The shop drawings and product data shall include, but not be limited to, the following:

1. A detailed description of equipment and operational procedures to accomplish the annular grouting operation, including mixing and pumping schedule, grouting pressures, rates of pumping, and methods to monitor the effectiveness of the grouting.

2. A detailed description and drawing indicating locations of surface mixing equipment, subsurface injection points, flowlines, waste grout recovery, and grout pressure limiting equipment, bulkhead design, and venting system.

3. Grout mix design and trial mix tests with set time, compressive strength, and density test results.

4. Qualifications and experience of grout mix applicator.

B. During pressure grouting operations, maintain and submit daily logs of grouting operations including pressure, grout volume pumped, and such other data as required by the Owner’s Representative.

1.04 PERFORMANCE REQUIREMENTS

A. The grout mix shall be designed to be pumpable through a 2-inch-diameter hose for a distance of 1,000 feet with a maximum allowable pressure at point of placement of 5 psi. The cast density shall be 55 pcf plus or minus 5 pcf. The minimum penetration

resistance after 24 hours shall be 100 psi in accordance with ASTM C403. The minimum compressive strength at 28 days shall be 200 psi, in accordance with ASTM C495. The grout mix shall have less than 1 percent shrinkage by volume.

B. The application system shall have sufficient gages, monitoring devices, and tests to determine the efficiency and effectiveness of the grouting work and provide means of accurately determining the amount of grout injected. The Contractor shall be prepared to modify or change his operation should the grouting not perform as proposed. Such modifications and changes shall be done in a timely manner to avoid unnecessary delay to the completion of the Project.

C. No deleterious amounts of toxic or other poisonous substances shall be included in the grout mix nor otherwise injected underground.

PART 2 P R O D U C T S

2.01 MANUFACTURERS/APPLICATORS

A. The applicator of the grout mix shall be certified by the grout mix manufacturer and approved by the Owner's Representative. The certified applicator shall be regularly engaged in the placement of grout, including completion of pipeline grouting installations.

2.02 MATERIALS

A. Cement: The cement shall comply with ASTM C150. Pozzolans and other cementitious materials are permitted.

B. Fly Ash: The fly ash shall comply with ASTM C618. Either Type C or Type F shall be used.

C. Sand, if provided, shall conform to ASTM C144, except as modified below:

U.S. Standard Sieve Size	Percent Passing by Weight
No. 16	100
No. 30	60-85
No. 50	10-35
No. 100	5-25

D. Water: Use potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the sliplining grout.

E. Admixtures: Admixtures shall be selected by the manufacturer of the sliplining grout to meet the performance requirements, to improve pumpability, to control set time, and to reduce segregation.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Owner's Representative shall be notified at least 24 hours in advance of grouting operations.

B. Grouting equipment and procedures shall be selected and operated with sufficient safety and care to avoid damage to existing underground utilities and structures.

3.02 EQUIPMENT

A. Mixers and Pumps: The grout shall be delivered to the injection point at a steady pressure with a nonpulsating centrifugal or triplex pump at the mix tank. Means shall be provided to increase or decrease the water-cement ratio. The system shall mix the grout to a homogeneous consistency. Means of accurately measuring grout component quantities, pumping pressures, and volumes pumped shall be provided.

B. Pressure Gauges. Contractor shall provide one pressure gauge at the point of injection and one pressure gauge at the grout pump. Grouting shall not proceed without appropriate gauges in place and in working order. Pressure gauges shall be equipped with diaphragm seals, have a working range between 1.5 to 2.0 times the design grout pressure, and have an accuracy within 0.5 percent of full range.

3.03 GROUTING

A. Scope: Grout shall be placed in the annular space between the sliplining pipe and the host sewer. The annular space shall be completely filled without deflecting the pipe greater than 1.5 percent. The grout equipment and procedures shall be tested in accordance with the Contractor submittals approved by the Owner's Representative. The test shall be performed on the first pipeline segment to be grouted and observed by the Owner's Representative. If the grout does not totally fill the annular space, the

Contractor shall adjust his procedure mix and rerun the test on the first pipeline segment.

B. Procedure:

1. The grout shall be placed for a given pipeline segment between bulkheads. Bulkheads shall be placed at the ends of each pipeline segment to seal the annular space from sewer flow. Bulkheads shall not be removed until after the grout has set.

2. The slipliner pipe shall be equipped with a weir to fill the slipliner pipe to prevent flotation during the grouting operation.

3. Standing or running water in the annular space shall be removed or controlled to maintain the correct water ratio of the grout mixture. The annular space shall be grouted by injecting grout from one end of the pipeline segment, allowing it to flow toward the other end. The annular space shall be vented to assure uniform filling of the void space.

4. Pressure on the annular space shall be limited to prevent damage to the liner and shall not exceed 5 psi. Regardless of the pressure, the Contractor shall be solely responsible for any damage or distortion to the slipliner pipe due to grouting. An open ended, high point tap or equivalent vent must be provided and monitored at the bulkhead opposite to the point of grouting.

5. Grout shall be pumped until a grout of within 0.3 pounds per gallon of specified grout injection density discharges from the end opposite the injection point. This procedure is intended to ensure that the grout is not diluted by extraneous water in the annulus.

6. The drilling of access holes from the surface to facilitate backfilling shall not be allowed.

3.04 FINAL CLEANUP

A. No hardened grout shall be permitted in the slipliner pipe invert after completion of grouting operations.

3.05 DEWATERING SYSTEM OPERATION

A. The dewatering system shall be operated until the grouting of the slipliner pipe is complete.

3.06 TESTING

A. Density: During placement of the grout, the density shall be measured in accordance with ASTM C138 a minimum of twice per hour. Adjust the mix as required to obtain the specified cast density.

B. Sampling:

1. Take four test specimens for each 100 cubic yards of grout or for each four hours of placing.

2. Test in accordance with ASTM C495 except:

a. The specimens shall be 3 inch by 6-inch cylinders covered after casting to prevent damage and loss of moisture. Moist cure specimens for a period up to 7 days prior to a 28-day compressive strength test.

b. Do not oven dry specimens that are load tested. Specimens may be tested at any age to monitor compressive strength. The material may require special handling and testing techniques.

END OF SECTION

SECTION 02510

ASPHALTIC CONCRETE PAVEMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Surface courses of compacted mixture of coarse and fine aggregates and asphaltic material.

1.02 UNIT PRICES

A. Measurement for asphaltic concrete pavement is on square yard basis. Separate measurement will be made for each different required thickness of pavement.

B. Payment for asphaltic concrete pavement includes payment for associated work performed in accordance with Section 02512 Tack Coat.

C. Payment for pavement repair or pavement replacement for utility projects is on a square yard basis and includes surface and base materials in accordance with Section 02571 - Pavement Repair for Utilities.

D. Payment for temporary detour pavement or temporary roadway and shoulder is on a square yard basis and includes surface and base materials, associated grading, maintenance and removal as well as restoration of ditches.

E. Payment for speed bumps and speed humps is on linear foot basis, and includes milling of existing pavement, tack coat, and placement and compaction of asphalt.

F. Refer to paragraph 3.08 for unit price adjustments.

1.03 SUBMITTALS

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

B. Submit certificates that asphaltic materials and aggregates meet requirements of Article 2.01, Materials, of this Specification Section.

C. Submit proposed design mix and test data for each type and strength of surface course in Work.

D. Submit manufacturer's description and characteristics of mixing plant for approval.

E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

F. Submit batch plant tickets for each truck load delivery of hot mix asphalt. Tickets should be delivered to Owner's Representative.

G. Submit the equipment specifications and details for the instrumentation and equipment for measuring the as-built transverse profile perpendicular to the centerline of the roadway asphalt finished surface from right bottom of curb (BC) to left BC at 25 feet intervals along the right of way. For example, a road laid for 100 feet will have five (5) transverse profiles. Longitudinal profiles shall be collected in the centerline of each lane which includes the parking lane. All longitudinal and transverse profiles of the finished asphalt shall be submitted for review.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Coarse Aggregate: Gravel or crushed stone, or combination thereof, that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic or other injurious matter occurring either free or as coating on aggregate. Aggregate shall conform to ASTM C33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C131. Aggregate by weight shall not contain more than 1.0 percent by weight of fine dust, clay- like particles, or silt when tested in accordance with Tex-217-F, Part II.

B. Fine Aggregate: Sand or stone screenings or combination of both passing No. 10 sieve. Aggregate shall conform to ASTM C33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by Tex-106-E. Sand equivalent shall have a minimum value of 45 when tested by Tex-203-F.

C. Composite Aggregate: Conform to the grading limits of TxDOT Item 340 for the paving type indicated on the drawings.

D. Asphaltic Material: Moisture-free homogeneous material which will not foam when heated to 347 degrees F, meeting following requirements:

VISCOSITY GRADE

Test	AC-10		AC-20	
	Min.	Max.	Min.	Max.
Viscosity, 140E strokes	1000	±200	2000	±400
Viscosity, 275E strokes	1.9	-	2.5	-
Penetration, 77E, 100 g, 5 sec.	85	-	55	-
Flash Point, C.O.C., F.	450	-	450	-
Solubility in trichloroethkene	99.0	-	99.0	-
Tests on residues from thin film oven tests:				
Viscosity, 140E strokes	-	3000	-	6000
Ductility, 77E, 5 cms per min., cms	70	-	50	-
Spot tests	Negative for all grades			

1. Material shall not be cracked

2. The Owner Representative will designate grade of asphalt to use after design tests have been made. Use only one grade of asphalt after grade is determined by test design for project.

2.02 EQUIPMENT

A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuously mixtures meeting specifications. Plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors. Provide equipment to supply materials adequately in accordance with rated

capacity of plant and produce finished material within specified tolerances. Following equipment is essential:

1. Cold aggregate bins and proportioning device.
2. Dryer.
3. Screens.
4. Aggregate weight box and batching scales.
5. Mixer.
6. Asphalt storage and heating devices.
7. Asphalt measuring devices.
8. Truck scales.

B. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix.

2.03 MIXES

A. Employ and pay certified testing laboratory to prepare design mixes. Test in accordance with Tex-126-E or Tex-204-F and Tex-208-F.

B. Density and Stability Requirements:

Percent Density		Percent	HVEEM Stability Percent
Min.	Max.	Optimum	Not Less Than
95	99	97	35

C. Proportions for Asphaltic Material: As specified in TxDOT Item 340 for the paving type shown on the Drawings.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted base course is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Prime Coat: If indicated on the Drawings, apply a prime coat conforming to requirements of Section 02511. Do not apply a tack coat until primed base has cured to satisfaction of the Owner's Representative.

B. Tack Coat: Conform to requirements of Section 02512.

C. Prepare subgrade in accordance with requirements of Section 02238 - Hot Mix Asphalt Base Course, Section 02244 - Cement Stabilized Base Course, or Section 02234 - Recycled Crushed Concrete Base Course.

D. Prepare subgrade in advance of asphalt concrete paving operation.

E. Perform pavement repair and resurfacing as indicated in Section 02951 - Pavement Repair and Restoration.

F. Milling of pavement for speed bumps and speed humps: Mill pavement (concrete or asphalt) to depth of one inch around entire perimeter of speed bump and speed hump.

3.03 PLACEMENT

A. Place asphaltic mixture when the roadway surface temperature is 60 degrees F or higher. Measure the roadway surface temperature with a handheld infrared thermometer. Unless otherwise shown on the plans, place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Owner Representative.

B. Haul prepared and heated asphaltic concrete mixture to the project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.

C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type.

D. Surface Course Material: Surface course 2 inches or less in thickness may be spread in one lift. Spread all lifts in such manner that, when compacted, finished course will be smooth, of uniform density, and will be to section, line and grade as shown. Coincide construction joints on surface courses with lane lines, or as directed by the Owner's Representative.

E. Place courses as nearly continuously as possible. Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back

laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.

F. When new asphalt is laid against existing or old asphalt, existing or old asphalt shall be saw cut full depth to provide straight smooth joint.

G. In restricted areas where use of paver is impractical, spread and finish asphalt by mechanical compactor. Use wood or steel forms, rigidly supported to assure correct grade and cross section. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove any lumps that do not break down readily. Place asphalt courses in same sequence as if placed by machine.

3.04 COMPACTION

A. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hairline cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water.

B. Compress surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing from 8 to 10 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and all rolling

marks are eliminated. Complete all rolling before mixture temperature drops below 175 degrees F.

C. Use tandem roller for final rolling. Double coverage with approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.

D. Along walls, curbs, headers and similar structures, and in all locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.

E. Compact binder course and surface course to density not less than 93 percent of the maximum possible density of voidless mixture composed of same materials in like proportions.

3.05 TOLERANCES

A. Furnish templates for checking surface in finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.

B. Completed surface, when tested with 10-foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct any surface not meeting this requirement.

C. Completed surface, when tested with pavement profiler shall show no deviation in excess of 1/8 inch in 10 feet per submittals 1.03G.

3.06 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Minimum of one core will be taken at random locations per 1,000 feet per lane of roadway or 1,000 square yards of asphalt concrete pavement to determine in-place depth and density.

C. In-place density will be determined in accordance with Tex-207-F and Tex-227-F from cores or sections of asphaltic base located near each core. Other methods of

determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by the Owner's Representative.

D. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

E. Fill cores and density test sections with new compacted asphaltic concrete pavement.

F. Measure pavement profile with a Walking Profiler G3 (Attached) or City Engineer Approved Equivalent in accordance with ASTM E2133-03 Standard Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles on a Travelled Surface. Profile will be evaluated by City and non-conforming pavement will be rejected and shall be repaired until it complies with the acceptable profile as determined by the City. Completed surface, when tested with pavement profiler shall show no deviation in excess of 1/8 inch in 10 feet per submittals 1.03G. Correct any surface not meeting this requirement, even if it means milling and relaying the asphalt to avoid repair patches.

3.07 NONCONFORMING PAVEMENT

A. Recompact pavement sections not meeting specified densities or replace them with new asphaltic concrete material. Replace with new material sections of surface course pavement not meeting surface test requirements or having unacceptable surface texture.

Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute.

B. Remove and replace areas of asphaltic concrete pavement found deficient in thickness by more than 10 percent. Use new asphaltic concrete pavement of thickness shown on Drawings.

C. Nonconforming pavement sections shall be replaced at no cost to Owner.

3.08 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to lower limit of 90 percent and upper limit of 100 percent of unit price bid.

3. Average depth below 90 percent may be rejected by the Owner's Representative.

3.09 PROTECTION

A. Do not open pavement to traffic until 12 hours after completion of rolling, or as shown on Drawings.

B. Maintain asphaltic concrete pavement in good condition until completion of Work.

C. Repair defects immediately by replacing asphaltic concrete pavement to full depth.

3.10 REFERENCES

A. ASTM C 33 - Standard Specification for Concrete Aggregates.

B. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C. TxDOT Tex-106-E - Calculating the Plasticity Index of Soils

D. TxDOT Tex-126-E - Molding, Testing, and Evaluating Bituminous Black Base Material.

E. TxDOT Tex-200-F - Sieve Analysis of Fine and Course Aggregates.

F. TxDOT Tex-203-F - Sand Equivalent Test.

G. TxDOT Tex-204-F - Design of Bituminous Mixtures.

H. TxDOT Tex 206-F - Compacting Test Specimens of Bituminous Mixtures.

I. TxDOT Tex-207-F - Determining Density of Compacted Bituminous Mixtures.

J. TxDOT Tex-208-F - Test for Stabilometer Value of Bituminous Mixtures.

K. TxDOT Tex-217-F - Determining Deleterious Material and Decantation Test for Coarse Aggregates.

L. TxDOT Tex-227-F - Theoretical Maximum Specific Gravity of Bituminous Mixtures.

M. TxDOT Tex-530-C - Effect of Water on Bituminous Paving Mixtures.TxDOT Tex-531-C - Prediction of Moisture Induced Damage to Bituminous Paving Materials Using Molded Specimens.

END OF SECTION



Walking Profiler G3

The Walking Profiler G3 is a high-precision measurement instrument for collecting surface condition information, at true walking speed.

The ARRB Walking Profiler (WP) G3 produces outputs from pavement profile, providing International Roughness Index (IRI), MPD texture (as an optional parameter) and distance.

Differing from previous generations, the WP unit utilises a tri-axial accelerometer mounted on a rolling platform, to enable measurement of longitudinal profile. This platform is separate to the carriage, which means it is less susceptible to operator input.

Data can be collected at variable speeds up to 5km/hr and is controlled by an Android tablet. Real-time results are displayed on the screen, allowing for on-site decision making. Data can then be uploaded to the cloud via a Wi-Fi connection or downloaded via USB cable.

Applications

- Provides outputs of IRI, longitudinal profile and distance
- Reference tool for calibrating and assessing high speed profilers
- Suitable for many surfaces, including:
  - paved roads and footpaths
  - airfields and runways
  - building slabs
  - bridges
  - carparks

precision profiling tool for manual applications

Features

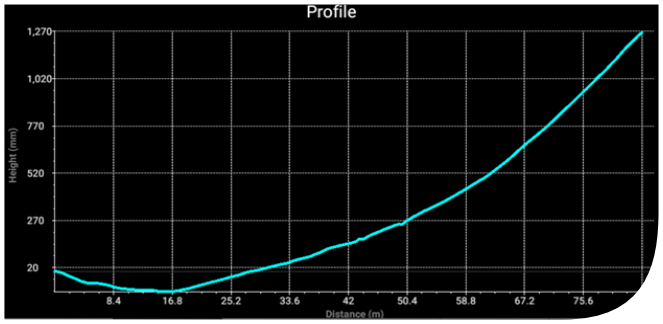
- World Bank Class 1 Profilometry device
- Varying collection speed options
- Option for MPD texture measurement
- Android tablet operation
- Bluetooth connectivity
- Outputs of ERD and PPF files, for use in ProVAL



Components

- Walking Profiler G3 unit
- Android tablet
- Battery charger
- Calibration plate and block
- Transportation case





bsi. ISO 9001 Quality Management

About ARRB

ARRB Group Ltd (ARRB) provides research, consulting and information services to the road and transport industry. ARRB applies research outcomes to develop equipment that collects road and traffic information and software that assists with decision making across road networks. ARRB is the leading provider of road research and best practice workshops in Australia. ARRB Group Ltd | ABN 68 004 620 651

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Walking Profiler G3 Datasheet

Condition	Specification
Compliance	ASTM E2133-03 *Standard Test Method for Using a Rolling inclinometer to Measure Longitudinal and Transverse Profiles on a Travelled Surface*
Speed of Operation	0 to 5km/h
Operation modes	Reference measurements: up to 1 km/h (repeatability >99%, accuracy > 98%)* General measurements: up to 3 km/h (repeatability >99%, accuracy >97%)* Quick measurements: 4-5 km/h (repeatability >97%, accuracy >94%)* Usage modes selectable from interface to aid decision of speed. Audible feedback given to user to aid in operation.
Transducers	1 tri-axial accelerometer, 1 wheel encoder, 1 temperature sensor, 1 laser (optional for texture measurement)
Units	Metric or Imperial
Data sample rate	> 2 kHz
Profile measurement interval (length)	25 mm
Wheel spacing	250 mm
Distance Accuracy	Typical error <0.045% (texture and ΔTemp dependant)
Weight	21.2 kg device only, 22.1 kg in use, 42.0 kg as shipped in case
Profilometry class	ASTM E950 Class 1, World Bank Class 1
Output Parameters	International Roughness Index (IRI), Mean Profile Depth (MPD)
Data Format	PPF, ERD, RAW (proprietary binary), CSV
IRI Accuracy	< 0.03 m/km (< ± 2 inches/mile) on high quality pavements
Wavelength measuring limits	Covers full range of roughness wavelengths up to several hundred metres
Warm up time	None (10 minutes with laser)
Battery Life	20+ hours
Operating temperature	5 - 45°C (41 - 113°F)
Data storage	10Gb on tablet, equivalent to more than 1,700km of profile data
Data transfer	Bluetooth connectivity between unit and tablet (no cables), upload to Cloud data storage via Wi-Fi
Components	Walking Profiler G3 Unit Samsung Galaxy Tab S8.4 Battery Charger Calibration equipment

*When compared to Rod and Level

SECTION 02521

CONCRETE PAVING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Portland Cement Concrete Paving.

1.02 UNIT PRICES

A. Measurement for concrete paving is on square yard basis. Separate measurement will be made for each different required thickness of pavement.

B. Refer to Paragraph 3.15 for unit price adjustments.

1.03 SUBMITTALS

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

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual compressive strength obtained from design mixes at required test ages.

C. Submit manufacturer's description and characteristics for mixing equipment, and for traveling form paver, if proposed for use, for approval.

D. Submit manufacturer's certificates giving properties of reinforcing steel. Provide specimens for testing when required by the Owner’s Representative.

1.04 HANDLING AND STORAGE

A. Do not mix different classes of aggregate without written permission of the Owner’s Representative.

B. Class of aggregate being used may be changed before or during Work with written permission of the Owner’s Representative. New class shall comply with specifications.

C. Segregated aggregate will be rejected. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.

D. Aggregates mixed with dirt, weeds or foreign matter will be rejected.

E. Do not dump or store aggregate in roadbed.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Portland Cement:

1. Sample and test cement to verify compliance with Standards of ASTM C150, Type I or Type III.

2. Bulk cement which meets referenced standards may be used if the method of handling is approved by the Owner's Representative. When using bulk cement, provide satisfactory weighing devices.

3. Fly ash which meets standards of ASTM C618 may be used as mineral fill if the method of handling is approved by the Owner's Representative.

B. Water: Fresh, clear and apparently clean conforming to requirements for water in ASTM C94.

C. Coarse Aggregate: Crushed stone or gravel, or combination thereof, which is clean, hard, and durable, conforms to requirements of ASTM C33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C131).

1. Maximum percentage by weight of deleterious substances shall not exceed following values:

Item	Percent by Weight of Total Sample Maximum
Clay lumps and friable particles	3.0
Material finer then 75-µm (No. 200) sieve:	
Concrete subject to abrasion	3.0*
All Other concrete	5.0*
Coal and lignite:	
Where surface appearance pf concrete is of importance	0.5
All other concrete	1.0

* In case of manufactured sand, if material is finer than 75-µm (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

2. Coarse aggregate (size 1-1/2 inch to No. 4 sieve) shall conform to requirements of ASTM C33. Gradation shall be within following limits when graded in accordance with ASTM C136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 1-3/4" sieve	0
Retained on 1-1/2" sieve	0 to 5
Retained on 3/4" sieve	30 to 65
Retained on 3/8" sieve	70 to 90
Retained on No. 4 sieve	95 to 100
Loss by Decantation Test	
*Method Tex-406-A	1.0 maximum

* In case of aggregates made primarily from crushing of stone, if material finer than the 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of Tex-406-A, percent may be increased to 1.5.

D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Fine aggregate for concrete shall conform to requirements of ASTM C33. Gradation shall be within following limits when graded in accordance with ASTM C136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 3/8" sieve	0
Retained on No. 4 sieve	0 to 5
Retained on No. 8 sieve	0 to 20
Retained on No. 16 sieve	15 to 50
Retained on No. 30 sieve	35 to 75
Retained on No. 50 sieve	65 to 90
Retained on No. 100 sieve	90 to 100
Retained on No. 200 sieve	97 to 100

1. When subjected to color test for organic impurities (ASTM C40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.

E. Mineral Filler: Class C fly ash of acceptable quality and meeting requirements of ASTM C618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, it shall be stored and inspected in accordance with ASTM C618. Fly ash shall not be used in amounts to exceed 30 percent by absolute volume of cementitious material in mix design. Cement content may be reduced if strength requirements can be met. Note: When fly ash is used, the term "cement" is defined as cement plus fly ash.

F. Air Entraining Agent: Furnish an air entraining agent conforming to requirements of ASTM C260.

G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C494 may be used if required to improve the workability of concrete. Amount and type of such admixture shall be subject to approval by the Owner's Representative.

H. Reinforcing Steel:

1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil or other injurious materials.

2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.

I. Fibrous Reinforcing: Conform to requirements of Section 03240. Not to be used in lieu of steel reinforcing.

2.02 EQUIPMENT

A. Equipment: Conform to requirements of ASTM C94.

2.03 MIXING

A. Employ and pay certified testing laboratory to prepare mix designs. Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C31 and tested in accordance with ASTM C39. Contractor shall determine and measure batch quantity of each ingredient, including all water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.

B. Mix design to produce concrete which will have compressive strength of 3000 psi at 7 days and 3500 psi at 28 days. When high-early-strength cement is used, it shall reach at least 3250 psi at 72 hours and 3500 psi at 28 days. Slump of concrete shall be at least 1 inch, but no more than 5 inches, when tested in accordance with ASTM C143.

1. Concrete pavement shall contain at least 5-1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water cement ratio maximum 0.57). Cement content shall be determined in accordance with ASTM C138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.

2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.

3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4-1/2 percent plus or minus 1-1/2 percent. Air content shall be determined by testing in accordance with ASTM C231.

4. Use retardant when temperature exceeds 90 degrees F. Proportion shall be as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify compacted base is ready to support imposed loads and meets compaction requirements.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.

B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

3.03 EQUIPMENT

A. Alternate equipment and methods, other than those required by this article, may be used provided the Contractor demonstrates that equal, or better, results will be obtained and if approved by the Owner's Representative. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.

B. Subgrade Planer and Template:

1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form at all times, and have such strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.

2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have such strength and rigidity that, when

supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1-foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.

C. Machine Finisher: Provide a power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires if it operates on concrete pavement.

D. Hand Finishing (Only to be used when approved by the Owner):

1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.

2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.

E. Belt Finishing: While concrete is still workable, give surface final belting to produce a uniform surface of gritty texture. Perform belting with short rapid transverse strokes having sweeping longitudinal motion.

F. Vibrators: Furnish mechanically operated synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.

G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship shall be met. If traveling form paver does not provide concrete paving that meets the compaction, finish and tolerances requirements of this specification, its use shall be immediately discontinued when so ordered by the Owner's Representative and conventional methods shall be used.

1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Float shall be long enough to extend across pavement to side forms or edge of slab.

2. Insure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations

inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.

3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace any pavement in which tie bars assume final position other than that shown on Drawings, unless corrective alternates are authorized in writing by the Owner's Representative.

3.04 FORMS

A. Side Forms: Use metal or wood forms of approved shape and section. Preferred depth of form shall be equal to required edge thickness of pavement. Forms with depths greater or less than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness is not greater than 1 inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to bottom of form, or by grouting under form. Aluminum forms are not allowed. All forms shall be approved by the Owner's Representative. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide reasonable straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used.

B. Form Setting:

1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by the Owner's Representative.

2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. These adjacent slabs shall not be used for forms until concrete has aged at least 7 days.

3.05 REINFORCING STEEL AND JOINT ASSEMBLIES

A. Accurately place reinforcing steel and joint assemblies and position them securely as indicated on Drawings. Tie reinforcing bars with wire securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Place all reinforcing steel and secure to chairs.

B. Place pavement joint assemblies at required locations and elevations, and rigidly secure all parts in required positions. Install dowel bars accurately in joint assemblies as shown, each parallel to pavement surface and to center line of pavement. Rigidly secure in required position to prevent displacement during placing and finishing of concrete. Accurately cut header boards, joint filler and other material used for forming joints to receive each dowel bar. Drill dowels into existing pavement, secure with epoxy, and provide paving headers, as required, to provide rigid pavement sections.

3.06 FIBROUS REINFORCING

A. Do not use fibrous reinforcing to replace structural, load bearing or moment reinforcing steel.

B. Mix and place in accordance with requirements of Section 03240 (Only when specified).

3.07 PLACEMENT

A. Place concrete only when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Concrete shall not be placed when temperature is below 40 degrees F and falling.

When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.

B. Place concrete within 90 minutes of mixing if concrete temperature is 85 degrees or less. Remove and dispose of concrete not placed within this period.

C. Concrete slump during placement shall be 1 to 5 inches, except when using traveling-form paver slump shall be maximum of 2 inches.

D. Deposit concrete rapidly and continuously on subgrade or subbase in successive batches. Distribute concrete to required depth and for entire width of placement in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At end of day or in case of unavoidable interruption of more than 30 minutes, place transverse construction joint at point of stopping work. Remove and replace sections less than 10 feet long.

E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

3.08 COMPACTION

A. Consolidate the concrete using mechanical vibrators as specified herein. Extend a vibratory unit across the pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.

B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

3.09 FINISHING

A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods (Hand finishing allowed only if approved by the Owner).

1. Use transverse finishing machine to make at least two trips over each area. Make last trip continuous run of not less than 40 feet. After transverse screeding, use hand-operated longitudinal float to test and level surface to required grade.

2. Hand finish with mechanical strike and tamping template as wide as pavement to be finished. Shape template to pavement section. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make at least two trips over each area. Screed pavement surface to required section. Work screed with combined transverse

and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.

C. While concrete is still workable, give surface final belting to produce a uniform surface of gritty texture and striations of 1/16" to 1/8"deep.

3.10 JOINTS AND JOINT SEALING

A. Conform to requirements of Section 02523.

3.11 CONCRETE CURING

A. Conform to requirements of Section 02525.

3.12 TOLERANCES

A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10-foot straightedge parallel to center of roadway to bridge any depressions and touch all high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10-foot straightedge shall not exceed 1/8 inch. Grind spots in excess of requirements of this paragraph to meet surface test requirements, only if approved by the Owner and Owner's representative. Restore texture by grooving concrete to meet surface finishing specifications.

3.13 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01410 - Testing Laboratory Services.

B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made for each 150 cubic yards or less of pavement that is placed in one day. Two specimens will be tested at 7 days or at number of hours as directed by the Project Manager for high early strength concrete. Test the remaining two specimens at 28 days. Specimens will be made, cured and tested in accordance with ASTM C-39. Minimum compressive strength shall be 3000 pounds per square inch at 7 days and 3500 pounds per square inch at 28 days.

C. Yield test will be made in accordance with ASTM C138 for cement content per cubic yard of concrete. If such cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.

D. Minimum of one 4-inch diameter core will be taken at random locations per 1,000 feet per lane or 1000 square yards of pavement to measure in-place depth. Each core may be tested for 28-day compressive strength according to methods of ASTM C42. The 28-day compressive strength of each core tested shall be a minimum of 3500 pounds per square inch.

E. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

F. Fill cores and density test sections with new concrete paving or non-shrink grout.

3.14 NONCONFORMING PAVEMENT

A. Remove and replace areas of pavement found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with concrete of thickness shown on Drawings unless accepted by the Owner's Representative.

B. Remove and replace pavement with unsatisfactory finish as determined by the Owner and Owner's Representative An unsatisfactory finish includes, but is not limited to, rain event that occurs during or after a concrete pour resulting in a poor finish, poor tooling, finishing or sections shall be replaced at no cost to Owner.

3.15 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to a lower limit of 90 percent of unit price bid.

3. No adjustment will be made for excess thickness.

3.16 PAVEMENT MARKINGS

A. Restore pavement markings to match those existing in accordance with standard specifications and details and the Owner's Representative's requirements.

3.17 PROTECTION

A. Barricade pavement section from use until concrete has attained minimum design strength.

B. On those sections of pavement to be opened to traffic, seal joints, clean pavement and place earth against pavement edges before permitting use by traffic. Such opening of pavement to traffic shall not relieve Contractor from his responsibility for Work.

C. Maintain concrete paving in good condition until completion of Work.

D. Repair defects by replacing concrete to full depth.

END OF SECTION

SECTION 02523

CONCRETE JOINTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Joints for concrete paving; concrete sidewalks; and curbs, and curb and gutter.

B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.02 UNIT PRICES

A. No separate payment will be made for concrete joints under this Section. Include payment in unit price for Concrete Paving.

B. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.

C. No separate payment will be made for joints or sawcutting for Curb, Curb and Gutter; Concrete Sidewalks; Wheelchair Ramps; and Concrete Driveways. Include payment in unit price for Curb and Gutter; Concrete Sidewalks; Wheelchair Ramps; and Concrete Driveways.

1.03 SUBMITTALS

A. Submit product data and samples in accordance with requirements of all sections and provisions of these specifications.

B. Submit product data for joint sealing compound and proposed sealing equipment for approval.

C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Board Expansion Joint Material: Filler board of selected stock. Use wood of density and type as follows:

1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.

2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

3. Use wood only when part of a load transmission device assembly.

B. Joint Sealing Compound:

1. Joint sealing compound shall be self-leveling Low Modulas Silicone sealant single component meeting the requirements of TxDOT Specification 433.2, Class 5.

C. Load Transmission Devices:

1. Smooth, steel dowel bars conforming to ASTM A615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.

2. Deformed steel tie bars conforming to ASTM A615, Grade 60.

D. Metal Supports for Reinforcing Steel and Joint Assembly: Employ metal supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by the Owner's Representative.

PART 3 E X E C U T I O N

3.01 PLACEMENT

A. When new work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.

B. If the limit of removal of existing concrete or asphaltic pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.

3.02 CONSTRUCTION JOINTS

A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 5 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.03 EXPANSION JOINTS

A. Place 3/4-inch expansion joints at locations shown on drawings. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2

lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings. Seal with joint sealing compound. Maximum spacing shall be 60 feet.

3.04 CONTRACTION JOINTS

A. Place formed groove contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Maximum spacing of contraction/construction joints is 20 feet, or as shown on plans. Polyethylene foam backer rods shall be installed in contraction joints. Seal groove with joint sealing compound.

3.05 LONGITUDINAL WEAKENED PLANE JOINTS

A. Place longitudinal weakened plane joints at spaces indicated on Drawings. Seal groove with joint sealing compound.

3.06 SAWED JOINTS

A. Contractor may use sawed joints as an alternate to formed groove contraction and weakened plane joints. Circular cutter shall be capable of cutting straight line groove 1/4 –3/8" inch wide. Depth shall be one quarter of pavement thickness plus 1/2 inch. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, it shall be continued until completed. Make saw cut with one pass. Complete sawing between 4 to 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.

B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Provide at least one standby saw in good working order. Maintain an ample supply of saw blades at work site at all times during sawing operations. Sawing equipment shall be on job at all times during concrete placement.

3.07 JOINTS FOR CURB, CURB AND GUTTER

A. Place 3/4-inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement; at end of radius returns at street intersections and driveways; and at curb inlets. Maximum spacing shall be 60-foot centers.

3.08 JOINTS FOR CONCRETE SIDEWALKS

A. Provide 3/4-inch expansion joints conforming to ASTM A1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 36 feet. Provide expansion joint material conforming to ASTM D994 for small radius curves and around fire hydrants and

utility poles. Extend the expansion joint material full depth of the slab. Reinforcing bars shall extend 10 inches beyond the expansion joint and then shall be wrapped with building paper, or approved sleeves, so that the 10 inches shall not be bonded to the concrete.

3.09 JOINTS FOR CONCRETE DRIVEWAYS

A. Provide 3/4-inch expansion joints conforming to ASTM D1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab. Where dowels are used, wrap or sleeve one end.

3.10 JOINT SEALING

A. Seal joints only when surface and joints are dry, ambient temperature is within manufacturers' recommendations and weather is not foggy or rainy.

B. Joint sealing equipment shall be in first-class working condition, and be approved by the Owner's Representative. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.

C. Clean joints of loose scale, dirt, dust and curing compound. Term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.

D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch below level of adjacent surface or at elevation as directed.

3.11 PROTECTION

A. Maintain joints in good condition until completion of Work.

B. Replace damaged joints material with new material as required by this Section.

END OF SECTION

SECTION 02525

CONCRETE PAVEMENT CURING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Curing of Portland Cement Concrete Paving.

1.02 UNIT PRICES

A. No separate payment will be made for concrete curing under this Section. Include payment in unit price for Concrete Paving; Concrete Sidewalks; Wheelchair Ramps; and Curb, Curb and Gutter.

1.03 SUBMITTALS

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

B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds

PART 2 P R O D U C T S

2.01 COVER MATERIALS FOR CURING

A. Curing materials shall conform to one of following:

1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C171.

2.02 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Liquid membrane-forming compounds shall conform to ASTM C309. Membrane shall restrict loss of water to not more than 0.55 kg/m^2 of surface in 72 hours.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Concrete pavement shall be cured by protecting it against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphaltic concrete.

B. Where curing requires use of water, curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

3.02 POLYETHYLENE FILM CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in the form of a fine spray. Cover surface with polyethylene film so film will remain in intimate contact with surface during specified curing period.

B. Cover entire surface and both edges of pavement slab. Joints in film sheets shall overlap minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or by replacing.

3.03 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Immediately after finishing surface, and after concrete has taken its initial set, apply liquid membrane-forming compound in accordance with manufacturer's instructions.

END OF SECTION

SECTION 02530

CONCRETE SIDEWALKS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Reinforced concrete sidewalks.

1.02 UNIT PRICES

A. Measurement for concrete sidewalks is on square foot basis.

B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

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

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.

C. Submit manufacturer's certificates giving properties of reinforcing steel. Provide specimens for testing when required by the Owner Representative.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Section 02521.

B. Reinforcing Steel: Conform to material requirements for reinforcing steel of Section 02521.

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

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

E. Sand Bed: Conform to material requirements for bank run sand of Section 02229.

PART 3 E X E C U T I O N

3.01 REPLACEMENT

A. Replace sidewalks which are removed or damaged during construction with sidewalk of thickness and width equivalent to one removed or damaged.

B. Provide replaced and new sidewalks with wheelchair ramps if sidewalk intersects curb at street or driveway intersection.

3.02 PREPARATION

A. Identify and protect utilities which are to remain.

B. Protect living trees, other plant growth, and features designated to remain.

C. Conduct clearing and grubbing operations in accordance with Section 02100.

D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to the line, grade and cross section. Compact subgrade, to a minimum of 95 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D698.

3.03 PLACEMENT

A. Forms: Straight, unwarped wood or metal forms with nominal 4-inch depth. Securely stake forms to line and grade, and maintain in true position during concrete placement.

B. Reinforcement: Install No. 3 reinforcing steel bars spaced in accordance with Drawing detail. Lay longitudinal bars in walk continuously, through expansion joints in accordance with Section 02523. Support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.

C. Expansion Joints: Install expansion joints in accordance with Section 02523.

D. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.

E. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.

F. Unless otherwise indicated on Drawings, mark off joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.

G. Finish edges with tool having 1/4-inch radius.

H. After concrete has set sufficiently, refill space along sides of sidewalk to top of walk with suitable material. Tamp unit firm and solid. Dispose of excess material in accordance with Section 01564.

3.04 CURING

A. Conform to requirements of Section 02525.

3.05 PROTECTION

A. Maintain sidewalks in good condition until completion of Work.

B. Replace damaged sidewalks in accordance with Paragraph 3.01 in this Section.

3.06 ACCESSIBILITY STANDARDS

A. All sidewalk and wheelchair ramp shall meet criteria of the Texas Accessibility Standards and the Federal Design Guidelines, i.e. slopes, texture and coloring. If applicable, the Texas Department of Licensing and Regulation (TDLR) shall inspect the site and rule on compliance. Any item found out of compliance shall be remedied at the expense of the Contractor.

END OF SECTION

SECTION 02531

CONCRETE DRIVEWAYS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Portland cement concrete driveways.

1.02 UNIT PRICES

A. Measurement for concrete driveways is on square yard basis.

1.03 SUBMITTALS

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

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Section 02521.

B. Reinforcing Steel: Conform to material requirements of Section 02521.

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

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

E. Sand Bed: Conform to material requirements for bank run sand of Section 02229.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Prepare subgrade in accordance with applicable portions of Sections 02221 through 02227 and 02241.

3.02 PLACEMENT

A. Place and finish concrete in accordance with applicable portions of Section 02521.

3.03 JOINTS

A. Install joints in concrete driveway in accordance with Section 02523.

3.04 CONCRETE CURING

A. Cure concrete driveway in accordance with Section 02525.

3.05 PROTECTION

A. Conform to applicable requirements of Section 02525.

END OF SECTION

SECTION 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 02571

PAVEMENT REPAIR FOR UTILITIES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

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

1. Parking areas, service drives, driveways, and sidewalks: Replace with material equal to or better than existing or as indicated on Drawings.

2. Street pavements and curbs, curbs and gutters: Match general pavement type and provide subgrade, base, and surface materials as indicated on the Drawings and as specified in this Section.

B. Repair State highway crossings in accordance with the highway department permit and within 1 week after utility work is installed.

C. Conform to Section 02076 - Removing Existing Pavement and Structures, for removal of existing pavements.

1.02 UNIT PRICES

A. Payment for pavement repair for utilities is on a unit price basis as listed in the Proposal Form.

B. Limits for measurement will be as shown on plans.

C. Total compensation for required Unit Price Work shall be included in Unit Price bid.

D. Quantity and measurement estimates stated in the Agreement are for contract purposes only. Quantities and measurements supplied or placed in the Work and verified by Owner's Representative shall determine payment as stated in Article 6 of the General Conditions.

E. The Contractor will verify all measurements and compute quantities accordingly. The Owner's Representative will verify these quantities.

F. Contractor shall assist by providing necessary equipment, workers, and survey personnel as required by Owner Representative.

1.03 NONCONFORMING PAVEMENT

A. Remove and replace areas of non-conforming Portland cement concrete or asphaltic concrete pavement found deficient in thickness by more than 10 percent, or that fail specified tests, unless accepted by Owner Representative.

1.04 UNIT PRICE ADJUSTMENT

A. For non-conforming pavement, accepted by the Owner Representative, unit price adjustments shall be made for actual in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

2. Adjustment shall apply to lower limit of 90 percent of unit price. No adjustments in price will be made for excess thickness.

1.05 SUBMITTALS

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

B. Submit test results or other data confirming that materials meet the specified requirements for:

1. Fill, backfill and subgrade materials

2. Base course materials

3. Asphalt materials and mix designs

4. Concrete materials and mix design

5. Joint material

PART 2 P R O D U C T S

2.01 SUBGRADE

A. Provide backfill material as required by Sections 02222 – Borrow, 02221 – Embankment, 02226 – Excavation and Backfill for Structures, 02227 – Excavation and Backfill for Utilities, 02228 – Extra Unit Price Work for Excavation and Backfill, and 02225 – Roadway and Backfill for Roadways.

2.02 BASE COURSE MATERIALS

A. Provide base material as required by applicable portions of Section 02233 Cement Stabilized Base Course, 02231 – Crushed Stone Flexible Base Course, 02234 – Recycled Crushed Concrete Base, and 02238 – Hot Mix Asphaltic Base Course.

2.03 PAVEMENT

A. Provide paving materials as required by applicable portions of Section 02510 - Asphaltic Concrete Pavement, Section 02521 – Concrete Paving, Section 02530 – Concrete Sidewalks, Section 02531 – Concrete Driveways, Section 02532 – Curb, Curb and Gutter, and Headers.

PART 3 E X E C U T I O N

3.01 EQUIPMENT

A. Alternate equipment and methods, other than those required by this section, may be used provided the Contractor demonstrates that equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting pavement in good working order.

3.02 PREPARATION

A. Subgrade: Prepare as required by Sections 02222 – Borrow, 02221 – Embankment, 02226 – Excavation and Backfill for Structures, 02227 – Excavation and Backfill for Utilities, 02228 – Extra Unit Price Work for Excavation and Backfill, and 02225 – Roadway and Backfill for Roadways.

B. Base: Prepare base material as required by applicable portions of Section 02233 Cement Stabilized Base Course, 02231 – Crushed Stone Flexible Base Course, 02234 – Recycled Crushed Concrete Base, and 02238 – Hot Mix Asphaltic Base Course.

C. Pavement: Provide paving materials as required by applicable portions of Section 02510 - Asphaltic Concrete Pavement, Section 02521 – Concrete Paving, Section 02530 – Concrete Sidewalks, Section 02531 – Concrete Driveways, Section 02532 – Curb, Curb and Gutter, and Headers.

D. Notify the Owner Representative prior to commencement of excavation in pavement for which an excavation in public right of way permit has been obtained. Follow directions contained in the permit.

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

F. When removing pavement to existing deformed metal strip, saw cut pavement a minimum of two inches deep on opposite side of deformed metal strip. Place saw joint far enough behind deformed metal strip to obtain continuously straight joint. Remove

damaged portion of deformed metal strip as required to provide proper joint. Saw cut and remove metal strip before placement of new concrete pavement.

G. Protect edges of existing pavement to prevent damage during removals, utility placement, backfill and paving operations. For concrete pavement, protect undisturbed subgrade that is to remain to support replacement slab.

H. Dowel in to existing pavement where no reinforcement is found or is broken due to construction activities. Unless otherwise directed by the Owner Representative, provide No. 6 reinforcing bars twenty four inches long, drilled and embedded twelve inches into center of existing slab with "PO-ROC" epoxy grout or approved equal. Space dowels to match new pavement reinforcement spacing.

I. Provide transitional paving, additional base depth and undercutting of existing pavement as required to tie proposed pavement to existing pavement when unable to dowel new pavement into existing pavement.

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

3.03 INSTALLATION

A. Parking Areas, Service Drives, Driveways and Sidewalks: Replace with material equal to or better than existing or as indicated on the Drawings. Conform to applicable requirements of sections referenced in Paragraph 2.01 Materials.

B. Street Pavements and Curbs, Curbs and Gutters: Replace subgrade, base and surface course with like materials or as indicated on the drawings and the City of Galveston Standard Details and Technical Specifications. Curbs and curbs and gutters shall match existing. Conform to requirements of sections referenced in Paragraph 2.01 Materials.

C. For concrete pavement, install size and length of reinforcing steel and pavement thickness indicated on the Drawings and the City of Galveston Standard Details and Technical Specifications. Place types and spacing of joints to match existing joints or as indicated on the Drawings.

D. Where existing pavement consists of concrete pavement with asphaltic surfacing, match existing thickness of the concrete pavement and asphalt surfacing.

E. Repair TxDOT highway and county crossings in accordance with TxDOT permit or county requirements as appropriate, and within one week after pavement removal.

3.04 WASTE MATERIAL DISPOSAL

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

3.05 PROTECTION

A. Maintain pavement in good condition until completion of the Work.

B. Replace pavement damaged by the Contractor's operations at not cost to the Owner.

END OF SECTION

SECTION 02600

CAST-IN-PLACE CONCRETE MANHOLES

PART 1 G E N E R A L

.01 SECTION INCLUDES

A. Cast-in-place sanitary and storm sewer manholes.

.02 UNIT PRICES

A. Measurement for payment for cast-in-place manholes is on a unit price basis per manhole. Payment will be made for each manhole installed, complete in place, including manhole, drop pipe, excavation, foundation, connection to sewer pipe, and backfill.

.03 SUBMITTALS

A. Conform to requirements of all sections and provisions of these specifications.

B. Submit proposed design mix and test data for each type and strength of concrete.

C. Submit manufacturer's data and details of following items for approval:

1. Frames, grates, rings, and covers.

2. Materials to be used in fabricating drop connections.

3. Materials to be used for pipe connections at manhole walls.

4. Materials to be used for stubs and stub plugs.

5. Plugs to be used for sanitary sewer hydrostatic testing.

PART 2 P R O D U C T S

.01 CONCRETE

A. Conform to requirements of Section 03305 - Concrete for Utility Construction.

B. Manholes - Class A concrete with minimum compressive strength of 4000 psi unless otherwise indicated on Drawings or approved by the Owner Representative for use on extra depth units.

.02 REINFORCING STEEL

A. Conform to requirements of Section 03305 - Concrete for Utility Construction.

.03 MORTAR

A. Conform to requirements of ASTM C 270, Type S using Portland cement.

.04 MISCELLANEOUS METALS

A. Provide cast-iron frames, grates, rings, and covers conforming to City Details.

.05 DROP CONNECTIONS AND STUBS

A. Drop connections and stubs shall conform to the same pipe material requirements used in the main pipe, unless otherwise indicated on the Drawings.

.06 PIPE CONNECTIONS

A. Use resilient connectors conforming to requirements of ASTM C 923. Metallic mechanical devices as defined in ASTM C 923 shall be made of the following materials:

1. External clamps: Type 304 stainless steel

2. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gage minimum.

3. Internal, expandable clamps on corrosion-resistant manholes:

a. Type 316 stainless steel, 11 gage minimum , or

b. Type 304 stainless steel, 11 gage minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C 213.

B. Where rigid joints between pipe and a cast-in-place manhole base are specified or shown on the Drawings, use polyethylene-isoprene waterstop meeting the physical property requirements of ASTM C 923, Press-Seal WS Series, or equal.

C. Storm sewer pipe connections:

1. Connections acceptable for sanitary sewers.

2. Line pipe grouted in place with mortar.

.07 SEALANT MATERIALS

A. Sealing materials between precast concrete adjustment ring and manhole cover frame shall be Adeka Ultraseal P201, or approved equal.

.08 CORROSION RESISTANT MANHOLE MATERIALS

A. Manholes shall be corrosion resistant only if stated on the drawings. The materials shall be applied by an approved certified applicator. Acceptable material is:

1. Raven 405 as manufactured by Raven Lining Systems, Inc., Tulsa, Oklahoma. The corrosion resistant barrier shall be spray applied as per the manufacturer's recommendation and shall have a minimum finished dry film thickness of 100 mils.

B. The Contractor shall have manufacturer's representative present on site at all times during the installation of corrosion resistant barrier

C. The Contractor shall make provisions in his unit price bid for each structure to maintain dry conditions for the corrosion resistant liner application and subsequent curing as per manufacturer's recommendations.

.09 BACKFILL MATERIALS

A. Backfill materials shall conform to the requirements of Section 02227 - Excavation and Backfill for Utilities.

.10 NON-SHRINK GROUT

A. For non-shrink grout, use prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. It shall meet the requirements of ASTM C 1107 and shall have a minimum 28-day compressive strength of 7000 psi.

PART 3 E X E C U T I O N

.01 EXAMINATION

A. Verify lines and grades are correct.

B. Determine if the subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. If it cannot be compacted to that density, the subgrade shall be moisture conditioned until that density can be reached or shall be treated as an unstable subgrade.

C. Do not build sanitary sewer manholes in ditches, swales, or drainage paths unless approved by the Owner Representative.

.02 MANHOLES

A. Construct manholes to dimensions shown on Drawings. Commence construction as soon as possible after pipes are laid. On monolithic sewers, construct manholes at same time sewer is being constructed.

B. Unstable Subgrade Treatment: When unstable subgrade is encountered the subgrade will be examined by the Owner Representative to determine if the subgrade has heaved upwards after being excavated. If heaving has not occurred, the subgrade shall be over-excavated to allow for a 24-inch thick layer of crushed stone wrapped in filter fabric as the foundation material under the manhole base. If there is evidence of heaving, a pile-supported concrete foundation, as detailed on the Drawings, shall be provided under the manhole base, when indicated by the Owner Representative.

C. Cast manhole foundations and walls monolithically. A cold joint with approved water stop will be allowed when the manhole flow line depth exceeds 12 feet. No other joints will be allowed unless shown on Drawings or approved by the Owner Representative.

D. Place, finish and cure concrete for manholes following the procedures given in Section 03305 - Concrete for Utility Construction, for concrete containing microsilica admixtures.

E. All manholes in pavement shall have blockouts.

.03 PIPE CONNECTIONS AT MANHOLE

A. Install approved resilient connectors at each pipe entering and exiting sanitary sewer manholes in accordance with manufacturer's instructions.

B. Ensure that no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter the space between the pipe and the edge of the wall opening at and around the resilient connector on either the interior or exterior of the manhole. If necessary, fill the space with a compressible material to guarantee the full flexibility provided by the resilient connector.

C. Where a new manhole is to be constructed on an existing sewer, install a waterstop gasket around the existing pipe at the center of the cast-in-place wall. Join ends of split waterstop material at the pipe springline using an adhesive recommended and supplied by the waterstop manufacturer.

D. Do not construct joints on sanitary sewer pipe within wall sections of manholes. Use approved connection material.

E. Construct pipe stubs with resilient connectors for future connections at locations and with material indicated on Drawings. Install approved stub plugs at interior of manhole.

F. Test connection for watertight seal before backfilling.

.04 INVERTS FOR SANITARY SEWERS

A. Construct invert channels to provide a smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inch per foot maximum.

2. Depth of bench to invert:

a. Pipes smaller than 15-inches: one-half largest pipe diameter

b. Pipes 15 to 24-inches: three-fourths the largest pipe diameter

c. Pipes larger than 24-inches: equal to the largest pipe diameter

3. Invert slope through manhole: 0.10-foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

B. Form invert channels with class A concrete if not integral with manhole base. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

.05 DROP CONNECTIONS FOR SANITARY SEWERS

A. Construct drop connections with same materials used in main pipe unless otherwise indicated on Drawings or approved by the Owner Representative. Install a drop connection with a sewer line enters a manhole higher than 30-inches above the invert of the manhole.

B. Encase drop assembly with class A concrete to form a solid mass. Extend concrete outside of bells a minimum of 4 inches. Cast base of encasement monolithically with manhole base and ensure concrete bonds to exterior manhole wall.

C. Terminate encasement of blind drops a minimum of 5 inches below top of bell and not less than 12 inches above top of next lower bell. Install approved plug at bell.

.06 MANHOLE FRAME AND ADJUSTMENT RINGS

A. Combine precast concrete adjustment rings so that the elevation of the installed casting cover is 3/8 inch below the pavement surface. Seal between adjustment ring and the manhole top with non-shrink grout; do not use mortar between adjustment rings. Apply a latex-based bonding agent to concrete surfaces to be joined with non-shrink grout. Set the cast iron frame on the adjustment ring in a bed of approved sealant. The sealant bed shall consist of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 3/4-inch wide.

B. For manholes in unpaved areas, top of frame shall be set a minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase the manhole frame in mortar or non-shrink grout placed flush with the face of the manhole ring and the top edge of the frame. Provide a rounded corner around the perimeter

.07 BACKFILL

A. Place and compact backfill materials in the area of excavation surrounding manholes in accordance with requirements of Section 02227 - Excavation and Backfill for Utilities. Use embedment zone backfill material, as specified for the adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to the manhole. Provide trench zone backfill, as specified for the adjacent utilities, above the embedment zone backfill.

B. Where rigid joints are used for connecting existing sewers to the manhole, backfill under the existing sewer up to the springline of the pipe with Class B concrete or flowable fill.

C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide a minimum of 4 inches of topsoil conforming to requirements of Section 02920 - Topsoil. Seed in accordance with Section 02932 - Hydromulch Seeding. If shown on Drawings, sod disturbed areas in accordance with Section 02935 - Sodding.

.08 FIELD QUALITY CONTROL

A. Conduct leakage testing of manholes in accordance with requirements of Section 02732 - Acceptance Testing for Sanitary Sewers.

.09 PROTECTION

A. Protect manholes from damage until subsequent work has been accepted. Repair or replace damaged elements of manholes at no additional cost to the Owner.

END OF SECTION

SECTION 02603

FRAMES, GRATES, RINGS, AND COVERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings and extensions.

B. Ring grates.

1.02 UNIT PRICES

A. No payment will be made for frames, grates, rings, covers, and seals under this Section. Include payment in unit price for related item.

1.03 SUBMITTALS

A. Submit product data in accordance with all sections and provisions of these specifications.

B. Provide copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.

C. Provide shop drawings for fabrication and erection of casting assemblies. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

PART 2 P R O D U C T S

2.01 CASTINGS

A. Castings for frames, grates, rings and covers shall conform to ASTM A48, Class 30. Provide locking covers if indicated on Drawings.

B. Castings shall be capable of withstanding the application of an AASHTO H-20 loading without permanent deformation.

C. Fabricate castings to conform to the shapes, dimensions, and with wording or logos shown on the Drawings.

D. Castings shall be clean, free from blowholes and other surface imperfections. Cast holes in covers shall be clean and symmetrical, free of plugs.

E. Castings shall be made in U.S.A.

F. Manhole cover and frame shall be called PAMREX or approved equal. Cover and frame shall be manufactured from ductile iron.

Covers shall be dually hinged and incorporate a 90 degree blocking system to prevent accidental closure. Covers shall be one man operable using standard tools and shall be capable of withstanding a test load of 80,000 lbs.

Frames shall be circular, incorporate a seating ring and a fitted plug in each hinge housing, and be available in a 32-inch clear opening. The frame depth shall not exceed 5-inches, and the flange shall incorporate bedding slots, bolt holes, and lifting eyes.

All components shall be black coated.

Frame weight: 107 lbs.
Cover weight: 162 lbs.
Total weight: 269 lbs.

DIMENSIONS (INCHES)			WEIGHT (lbs)		
A	O	H	COVER AND FRAME	COVER ONLY	REFERENCE
39 4/10	32	5	269	162	RE 32 R8 FD

2.02 BEARING SURFACES

A. Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for any position in which the casting may be seated in the frame.

2.03 FABRICATED RING GRATES

A. Ring grates shall be fabricated from reinforcing steel conforming to ASTM A615.

B. Welds connecting the bars shall conform to AWS D12.1.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install castings according to approved shop drawings, instructions given in related specifications, and applicable directions from the manufacturer's printed materials.

B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in formwork until permanently set.

C. Ring grates shall be fabricated in accordance with drawings and shall be set in mortar in the mouth of the pipe bell.

END OF SECTION

SECTION 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 02618

CENTRIFUGALLY CAST FIBERGLASS PIPE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Centrifugally Cast Fiberglass Reinforced Plastic (FRP) Pipe for sanitary sewers.

1.02 UNIT PRICES

A. No payment will be made for fiberglass pipe under this Section. Include in unit price for Section 02730 - Gravity Sanitary Sewers or Section 02731 - Sanitary Sewage Force Mains.

1.03 SUBMITTALS

A. Conform to requirements of all provisions and sections of these specifications.

B. Provide sufficient data for the Owner's Representative to properly evaluate the pipe.

C. Product data submittals shall include the following, as a minimum:

1. Details of the proposed pipe.

2. Properties and strengths of the pipe.

3. Details of pipe joint.

4. Pipe design analysis.

5. Instruction on storage, handling, transporting, and installation.

6. Standard catalog sheets.

D. Test Reports: Provide test reports upon request, certifying that the pipe has been tested in accordance with and exceeds minimum requirements of ASTM D 3262 and ASTM D 3681.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. Preapproved manufacturers for centrifugally cast fiberglass pipe is Hobas Pipe USA, Inc., Ameron FCPD or approved equal.

2.02 MATERIALS

A. Resin Systems: The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been collected from applications of a composite material of similar construction and composition as the proposed product.

B. Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade glass filaments with binder and sizing compatible with impregnating resins.

C. Fillers: Silica sand or other suitable materials may be used.

D. Additives: Resin additives, such as pigments, dyes, and other coloring agents, if used, shall in no way be detrimental to the performance of the product nor shall they impair visual inspection of the finished products.

E. Rubber Gaskets: Supply from an approved gasket manufacturer in accordance with ASTM F 477, when no contaminant is identified and suitable for the service intended. Gaskets shall either be affixed to the pipe by means of a suitable adhesive or shall be installed in such a manner so as to prevent the gasket from rolling out of the pre-cut groove in the pipe or sleeve coupling. When pipe is to be installed in potentially contaminated areas as shown on the plans or identified in the field by the Owner's Representative, especially where free product is found near the elevation of the proposed sewer, provide 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

F. The internal liner resin shall be suitable for service as sewer pipe, and shall be highly resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases. Pipe shall meet or exceed requirements of ASTM D 3681.

2.03 MANUFACTURE AND CONSTRUCTION

A. Pipes

1. Furnish pipes in the diameters specified and within the tolerances specified below.

2. Manufacture pipe by the centrifugal casting process to result in a dense, nonporous, corrosion-resistant, consistent composite structure to meet the operating conditions as shown on the Drawings.

3. Do not use stiffening ribs or rings.

B. Couplings: Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D 4161.

C. Fittings: Flanges, elbows, reducers, tees, and other fittings shall be capable of withstanding operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays.

D. Manhole Connections: Provide a water stop flange (wall pipe) for connection to a cast-in-place manhole base or other structure.

E. Grout Ports: Provide grout ports in the wall of pipe when required by Section 02330 - Tunnel Grout. Provide plugs of 316 stainless steel or other corrosion-resistant material compatible with the pipe. Grout port plugs shall be designed and installed to meet the test pressure of the pipe.

2.04 DIMENSIONS

A. Diameters: The actual outside diameter of the pipes shall be in accordance with Table 3 of ASTM D 3262 for gravity sewers, or ASTM D 3754 for force mains.

B. Lengths: The pipe standard length will be approximately 20 feet. A maximum of 10 percent of the lengths, excluding special order pipes, may be supplied in random lengths.

C. Wall Thickness: The minimum average wall thickness shall be the stated design thickness. The minimum single point thickness shall not be less than 90 percent of the stated design thickness.

D. End Squareness: Pipe ends shall be square to the pipe axis.

E. Tolerance of Fittings: The tolerance of the angle of an elbow and the angle between the main and leg of a wye or tee shall be plus or minus 2 degrees. The tolerance on the laying length of a fitting shall be plus or minus 2 inches.

2.05 STIFFNESS CLASSES

A. Stiffness class of FRP pipe shall satisfy design requirements, but shall not be less than 46 psi, when used in direct bury operation; 36 psi, when installed within a primary tunnel liner.

B. Stiffness class of FRP in a pipe jacking operation shall be governed either by the ring deflection limitations or by a pipe design providing longitudinal strength required by the jacking method and shall satisfy design requirements stated below. Submit design calculations as required in Paragraph 1.04, Submittals.

1. Ring deflection calculations shall conform with design requirements of 30 TAC Chapter 317.20 pertaining to flexible pipe used in gravity sewers. The pipe deflection calculations shall ensure that predicted deflection will be less than 5 percent under long-term loading conditions (soil prism load) for the highest density of soil overburden and surcharge loads. Deflection on calculations shall be prepared using long-term (drained) values for soil parameters contained in the geotechnical investigation report for the Project, or other site-specific data obtained by the Contractor as approved by the Owner's Representative.

2. Pipe stress calculations based in jacking loads shall be performed to conform with Section 02312- Microtunneling and Pipe-Jacked Tunnels.

2.06 TESTING

A. Pipes shall be tested in accordance with ASTM D 3262 or ASTM D 3754, as applicable, except that the factory hydrostatic pressure testing is not required.

B. Joints: Coupling joints shall be qualified per the tests of Section 7 of ASTM D 4161.

2.07 CUSTOMER INSPECTION

A. The Owner's Representative shall be entitled to inspect pipes or witness the pipe manufacturing. Such inspection shall not relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications.

B. Manufacturer's Notification to Customer: Should the Owner's Representative wish to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Owner's Representative with adequate advance notice of when and where the production of those pipes will take place.

C. Failure to Inspect: Should the Owner's Representative elect not to inspect the manufacturing, testing, or finished pipes, it in no way implies approval of products or tests.

2.08 PACKAGING, HANDLING, AND SHIPPING

A. Packing, handling, and shipping should be done in accordance with the manufacturer's instructions.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. The installation of pipe and fittings shall be in accordance with requirements of Section 02730 - Gravity Sanitary Sewers and 02731 - Sanitary Sewage Force Mains.

B. The manufacturer must supply a suitable qualified field service representative to be present periodically during the installation of pipe.

C. Pipe Bedding: Conform to requirements of Section 02227 - Excavation and Backfill for Utilities.

D. Pipe Handling: Use textile slings.

E. Jointing

1. Clean ends of pipe and coupling components.

2. Check pipe ends and couplings for damage. Correct any damage found.

3. Coupling grooves must be completely free of dirt.

4. Apply joint lubricant to pipe ends and rubber seals of coupling. Use only lubricants approved by the pipe manufacturer.

5. Use suitable auxiliary equipment, such as a wire rope puller, to pull joints together.

6. Do not exceed forces recommended by the manufacturer for coupling pipe. If excessive force is required, remove coupling, determine source of problem, and correct it.

7. In the process of jointing the pipe, do not allow the deflection angle to exceed the deflection permitted by the manufacturer.

F. If pressure grouting of the pipe is conducted as part of a pipe-jacked tunnel installation, seal the grout holes with liner resin to a thickness equal to the pipe liner thickness, or with a threaded plug for that purpose.

G. Tests: Conform to requirements of Section 02732 - Acceptance Testing for Sanitary Sewers.

END OF SECTION

SECTION 02619

HIGH DENSITY POLYETHYLENE (HDPE)
SOLID WALL PIPE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. High Density Polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.

B. HDPE pipe for sanitary sewer force mains, including fittings.

1.02 UNIT PRICES

A. No separate payment will be made for HDPE pipe under this Section. Include cost in unit prices for gravity sanitary sewers and storm sewers.

1.03 SUBMITTALS

A. Conform to requirements of all sections and provisions of these specifications.

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

1.04 QUALITY CONTROL

A. Provide the manufacturer's certificate of conformance to the Specifications.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

PART 2 PR O D U C T S

2.01 APPROVED AND PREAPPROVED PRODUCTS

A. For pipe bursting/crushing existing sanitary sewers refer to Section 02768 – Pipe Bursting/Crushing Sanitary Sewers

B. Solid wall pipe shall be produced with plain end construction for heat-joining (butt fusion) conforming to ASTM D2657. Utilize controlled temperatures and pressures for joining to produce a fused leak-free joint.

B. Furnish solid wall pipe for sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings.

2.02 MATERIALS

A. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting the requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D1248. Material meeting the requirements of cell classification in accordance with ASTM D3350 is also suitable for making pipe products under these specifications.

B. Gaskets

1. Use gaskets meeting requirement of ASTM F477. Use gasket molded into a circular form or extruded to the proper section and then spliced into circular form. When no contaminant is identified, use gaskets of a properly cured, high-grade elastomeric compound. The basic polymer shall be natural rubber, synthetic elastomer, or a blend of both.

2. Pipes to be installed in potentially contaminated areas as shown on the plans or indentified in the filed by the owner representative, especially where free product is found near the elevation of the proposed sewer, shall have the following gasket materials for the noted contaminants:

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other Contaminants	As recommended by the pipe manufacturer

C. Lubricant. Use a lubricant for assembly of gasketed joints which has no detrimental effect on the gasket or on the pipe, in accordance with manufacturer's recommendations.

2.03 WORKMANSHIP

A. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.

2.04 INSPECTIONS

A. The Owner Representative reserves the right to inspect pipes or witness pipe manufacturing. Such inspection shall in no way relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications.

B. Manufacturer's Notification to Customer. Should the Owner Representative wish to witness the manufacture of specific pipes, the manufacturer shall provide the Owner’s Representative with adequate advance notice of when and where the production of those specific pipes will take place.

C. Failure to Inspect. Approval of the products or tests is not implied by the Owner Representative's decision not to inspect the manufacturing, testing, or finished pipes.

2.05 TEST METHODS

A. Conditioning. Conditioning of samples prior to and during tests is subject to approval by the Owner Representative. When referee tests are required, condition the specimens in accordance with Procedure A in ASTM D618 at 73.4 degrees F plus or minus 3.6 degrees F (23 degrees C plus or minus 2 degrees C) and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under the same conditions of temperature and humidity unless otherwise specified.

B. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in a suitable press until the internal diameter has been reduced to 40 percent of the original inside diameter of the pipe. The rate of loading shall be uniform and at 2-inches per minute. The test specimens, when examined under normal light and with the unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of the pipe walls or bracing profiles.

C. Joint Tightness. Test for joint tightness in accordance with ASTM D3212, except replace the shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to the pipe's outer contour.

D. Purpose of Tests. The flattening and the joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

2.06 MARKING

A. Mark each standard and random length of pipe in compliance with these Specifications with the following information:

1. Pipe size

2. Pipe class

3. Production code

4. Material designation

PART 2 E X E C U T I O N

2.01 INSTALLATION

A. Conform to requirements of the following Sections:

1. Section 02730 - Gravity Sanitary Sewers

2. Section 02761 - Sliplining Sanitary Sewers

B. Install pipe in accordance with the manufacturer's recommended installation procedures.

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 02630

POLYETHYLENE WRAP

PART 1 - G E N E R A L

1.01 SECTION INCLUDES

A. Polyethylene wrap for cast and ductile iron pipe to be used only in open-cut construction when cathodic protection system is not required by Drawings.

1.02 UNIT PRICES

A. No separate payment will be made for polyethylene wrap. Include cost of polyethylene wrap in unit price for items wrapped.

1.03 SUBMITTALS

A. Submit product data in accordance with all provisions and sections of these specifications.

B. Submit product data for proposed film and tape for approval.

PART 2 - P R O D U C T S

2.01 MATERIALS

A. Polyethylene Film: Tubular or sheet form without tears, breaks, holidays or defects: conforming to requirements of AWWA C 105, 2.5 to 3 percent carbon black content, either low- or high-density:

1. Low-density polyethylene film. Low-density polyethylene film shall be manufactured of virgin polyethylene material conforming to the following requirements of ASTM D 1248.

a. Raw material.

1) Type : I

2) Class: C (black)

3) Grade: E-5

4) Flow rate (formerly melt index): 0.4 g/10 minute, maximum

5) Dielectric strength: Volume resistivity, 10^{15} ohm-cm, minimum

b. Physical properties.

1) Tensile strength: 1200 psi, minimum

2) Elongation: 300 percent, minimum

3) Dielectric strength: 800 V/mil thickness, minimum

c. Thickness: Low-density polyethylene film shall have a normal thickness of 0.008 inch. The minus tolerance on thickness is 10 percent of the nominal thickness.

2. High-density, cross-laminated polyethylene film. High-density, cross laminated polyethylene film shall be manufactured of virgin polyethylene material conforming to the following requirements of ASTM D 1248

a. Raw material.

1) Type: III

2) Class: C (black)

3) Grade: P33

4) Flow rate (formerly melt index): 0.4 to 0.5g/10 minute, maximum

5) Dielectric strength: Volume resistivity, 10^{15} ohm-cm, minimum

b. Physical properties.

1) Tensile strength: 5000 psi, minimum

2) Elongation: 100 percent, minimum

3) Dielectric strength: 800 V/mil thickness, minimum

c. Thickness: Film shall have a nominal thickness of 0.004 inch. The minus tolerance of thickness is 10 percent of the nominal thickness.

3. Polyethylene Tape: Provide 3-inch wide, plastic-backed, adhesive tape; Polyken No. 900, Scotchwrap No. 50, or equal.

PART 3 - E X E C U T I O N

3.01 INSTALLATION

A. Preparation:

1. Remove all lumps of clay, mud, cinders, etc., on pipe surface prior to installation of polyethylene encasement. Prevent soil or embedment material from becoming trapped between pipe and polyethylene.

2. Fit polyethylene film to contour of pipe to effect a snug, but not tight; encase with minimum space between polyethylene and pipe. Provide sufficient slack in contouring to prevent stretching polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to polyethylene due to backfilling operations. Secure overlaps and ends with adhesive tape to hold polyethylene encasement in place until backfilling operations are complete.

3. For installations below water table and/or in areas subject to tidal actions, seal both ends of polyethylene tube with adhesive tape at joint overlap.

B. Tubular Type (Method A):

1. Cut polyethylene tube to length approximately 2 feet longer than pipe section. Slip tube around pipe, centering it to provide 1-foot overlap on each adjacent pipe section, and bunching it accordion-fashion lengthwise until it clears pipe ends.

2. Lower pipe into trench and make up pipe joint with preceding section of pipe. Make shallow bell hole at joints to facilitate installation of polyethylene tube.

3. After assembling pipe joint, make overlap of polyethylene tube. Pull bunched polyethylene from preceding length of pipe, slip it over end of new length of pipe, and secure in place. Then slip end of polyethylene from new pipe section over end of first wrap until it overlaps joint at end of preceding length of pipe. Secure overlap in place. Take up slack width at top of pipe to make a snug, but not tight, fit along barrel of pipe, securing fold at quarter points.

4. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

C. Tubular Type (Method B):

1. Cut polyethylene tube to length approximately 1 foot shorter than pipe section. Slip tube around pipe, centering it to provide 6 inches of bare pipe at each end. Take up slack width at top of pipe to make a snug, but not tight, fit along barrel of pipe, securing fold at quarter points; secure ends.

2. Before making up joint, slip 3-foot length of polyethylene tube over end of preceding pipe section, bunching it accordion-fashion lengthwise. After completing joint, pull 3-foot length of polyethylene over joint, overlapping polyethylene previously installed on each adjacent section of pipe by at least 1 foot; make each end snug and secure.

3. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

D. Sheet Type:

1. Cut polyethylene sheet to a length approximately 2 feet longer than pipe section. Center length to provide 1-foot overlap on each adjacent pipe section, bunching it until it clears pipe ends. Wrap polyethylene around pipe so that it circumferentially overlaps top quadrant of pipe. Secure cut edge of polyethylene sheet at intervals of approximately 3 feet.

2. Lower wrapped pipe into trench and make up pipe joint with preceding section of pipe. Make shallow bell hole at joints to facilitate installation of polyethylene. After completing joint, make overlap and secure ends.

3. Repair cuts, tears, punctures, or other damage to polyethylene. Proceed with installation of next section of pipe in same manner.

E. Pipe-shaped Appurtenances: Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in same manner as pipe.

F. Odd-shaped Appurtenances: When it is not practical to wrap valves, tees, crosses, and other odd-shaped pieces in tube, wrap with flat sheet or split length of polyethylene tube by passing sheet under appurtenance and bringing it up around body. Make seams by bringing edges together, folding over twice, and taping down. Tape polyethylene securely in place at valve stem and other penetrations.

G. Repairs: Repair any cuts, tears, punctures, or damage to polyethylene with adhesive tape or with short length of polyethylene sheet or cut open tube, wrapped around pipe to cover damaged area, and secured in place.

H. Openings in Encasement: Provide openings for branches, service taps, blow offs, air valves, and similar appurtenances by making an X-shaped cut in polyethylene and temporarily folding back film. After appurtenance is installed, tape slack securely to appurtenance and repair cut, as well as other damaged area in polyethylene, with tape. Service taps may also be made directly through polyethylene, with any resulting damaged areas being repaired as described above.

I. Junctions between Wrapped and Unwrapped Pipe: Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend polyethylene wrap to cover adjacent pipe for distance of at least 3 feet. Secure end with circumferential turns of tape. Wrap service lines of dissimilar metals with polyethylene or suitable dielectric tape for minimum clear distance of 3 feet away from cast or ductile iron pipe.

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 02642

AIR RELEASE AND VACUUM RELIEF VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Air release and vacuum relief valves.

1.02 UNIT PRICES

A. Measurement is on a lump sum basis for each valve installed.

B. Payment includes air release valve manholes and fittings and appurtenances necessary for complete installation of valve. The Owner's Representative may request a detailed schedule of values for more complex installations.

1.03 SUBMITTALS

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

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

1.04 QUALITY CONTROL

A. Provide manufacturer's affidavit that air release and vacuum relief valves purchased for Work, were manufactured and tested in the United States, and conform to applicable requirements of this Section.

PART 2 P R O D U C T S

2.01 GENERAL

A. Combination air valve called for on Drawings means combination valve designed to fulfill functions of air release (permit escape of air accumulated in line at high point of elevation while line is under pressure) and vacuum relief. Air release and vacuum relief valves 8 inches and smaller in diameter shall be self-contained in one unit.

2.02 MATERIALS

A. Air Release Valves: Apco No. 200, GA Industries Fig. 2-AR, or equal. Materials: body and cover, ASTM A48, Class 30, cast iron; float and leverage mechanism, ASTM A240 or A276 stainless steel; orifice and seat, stainless steel against Buna-N

or Viton mechanically retained with hex head nut and bolt; other valve internals, stainless steel or bronze. Provide inlet and outlet connections, and orifice as shown on Drawings.

B. Air Release and Vacuum Valves: Provide single-body, standard combination or duplex-body custom combination valves as indicated on Drawings.

1. For 2-inch and 3-inch, single-body valves, provide inlet and outlet sizes as shown on Drawings and orifice sized for 100 psi working pressure. Valve materials: body, cover and baffle, ASTM A48, Class 35, or ASTM A126, Grade B cast iron; plug or poppet, ASTM A276 stainless steel; float, ASTM A240 stainless steel; seat, Buna-N; other valve internals, stainless steel. Valve exterior: Painted with shop-applied primer suitable for contact with potable water. Provide Apco Model 145C or 147C, Val-Matic Series 200, or equal valves.

2. For 3-inch and larger duplex body valves as shown on Drawings, provide Apco Series 1700 with No. 200 air release valve, GA Industries Fig. No. AR/GH-21K/280, or equal. Air and vacuum valve materials: body and cover, ASTM A48, Class 35, cast iron; float, ASTM A240 stainless steel; seat, Type-304, stainless steel and Buna-N; other valve internals, stainless steel or bronze. Air release valve: Constructed as specified in paragraph above on Air Release Valves.

C. Vacuum Relief Valves: Provide air inlet vacuum relief valves with flanged inlet and outlet connections as shown on Drawings. Provide air release valves in combination with inlet and outlet, and orifice as shown on Drawings. Valve shall open under pressure differential not to exceed 0.25 psi. Provide Apco Series 1500 with a No. 200A air release valve, GA Industries Fig. No. HCARV, or equal. Materials for vacuum relief valves: valve body, ASTM A48, Class 35, cast iron; seat and plug, ASTM B584 bronze, copper alloy 836; spring, ASTM A313, Type-304, stainless steel; bushing, ASTM B584 bronze, copper alloy 932; retaining screws, ASTM A276, Type-304, stainless steel.

D. Air Release Valve Vault as detailed in Drawings.

PART 3 E X E C U T I O N

3.01 EARTHWORK

A. Conform to applicable provisions of Section 02227.

3.02 SETTING VALVES AND VALVE BOXES

A. Provide services of technical representative of valve manufacturer available on site during installation of valves.

B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that all parts are in satisfactory working condition.

C. Install valves and valve boxes where indicated on Drawings or as located by the Owner's Representative. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face if less than 4 feet. Provide above-ground vents for valve boxes as indicated on drawings.

3.03 DISINFECTION AND TESTING

A. Disinfect valves and appurtenances as required by Section 02675 and test as required by Section 02676.

3.04 PAINTING OF PIPING

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

END OF SECTION

SECTION 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 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 02730

GRAVITY SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Gravity sanitary sewers and appurtenances, including cleanouts, stacks, and service connections.

1.02 UNIT PRICES

A. Measurement for payment of pipe is on a unit price per linear foot basis. Measurement will be taken along the centerline of the pipe from centerline to centerline of manholes. Payment will be made for each linear foot installed, complete in place including sewer pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes and pipe, stacks, cleanouts, accessories, inspection and testing..

1.03 SUBMITTALS

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

B. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

1.04 QUALITY ASSURANCE

A. Qualifications. Install a sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Section 02732 - Acceptance Testing for Sanitary Sewers.

B. Regulatory Requirements.

1. Install sewer lines to meet the minimum separation distance from any potable water line, as scheduled below. The separation distance is defined as the distance between the outside of the water pipe and the outside of the sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.

2. Make notification to the Owner's Representative if water lines are uncovered during sanitary sewer installation where the minimum separation distance cannot be maintained.

3. Lay gravity sewer lines in straight alignment and grade.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Inspect pipe and fittings upon arrival of materials at the job site.

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

C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around the outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with the interior surface of the pipe to lift or move lined pipe.

PART 2 P R O D U C T S

2.01 PIPE

A. Provide piping materials for gravity sanitary sewers of the sizes and types indicated on the Drawings or as specified.

B. Reinforced concrete pipe is not acceptable.

2.02 PIPE MATERIAL SCHEDULE

A. Unless otherwise shown on the Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:

1. Section 02610 - Ductile Iron Pipe and Fittings.

2. Section 02618 - Centrifugally Cast Fiberglass Pipe.

3. Section 02619 - HDPE Solid and Profile Wall Pipe.

4. Section 02620 - PVC Pipe.

B. Where shown on the Drawings, provide pipe meeting the minimum class, dimension ratio, or other criteria indicated.

C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

2.03 APPURTENANCES

A. Stacks. Conform to the requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

B. Service Connections. Conform to requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

C. Roof, street or other type of surface water drains shall not be connected or reconnected into the sanitary sewer lines.

2.04 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill: Conform to requirements of Section 02227 - Excavation and Backfill for Utilities, Section 02229 - Utility Backfill Material, and Section 02252 - Cement Stabilized Sand.

B. Topsoil: Conform to requirements of Section 02920 - Topsoil.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Prepare traffic control plans if required, or follow traffic control plan provided within the construction plans, and set up street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01570 - Traffic Control and Regulation.

B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Section 01570 - Traffic Control and Regulation. Maintain barricades and warning lights where work is in progress or where traffic is affected by the work.

C. Perform work in accordance with OSHA standards. Employ a trench safety system as specified in Section 01526 - Trench Safety System for excavations over 5 feet deep.

D. Immediately notify the agency or company owning any utility line which is damaged, broken or disturbed. Obtain approval from the Owner's Representative and agency or utility company for any repairs or relocations, either temporary or permanent.

E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Section 02076 - Removing Existing Pavements and Structures.

F. Install and operate dewatering and surface water control measures in accordance with Section 01563 - Control of Ground Water and Surface Water.

G. Do not allow sand, debris or runoff to enter sewer system.

3.02 DIVERSION PUMPING

A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from the Owner's Representative.

B. Design piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. No sewage shall be diverted into any area outside of the sanitary sewer.

D. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify the Owner's Representative so that required reporting can be made to the Texas Commission on Environmental Quality and the Environmental Protection Agency.

3.03 EXCAVATION

A. Earthwork. Conform to requirements of Section 02227 - Excavation and Backfill for Utilities. Use bedding as indicated on Drawings.

B. Line and Grade. Establish the required uniform line and grade in the trench as shown in the drawings. Maintain this control for a minimum of 100 feet behind and ahead of the pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of the work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect the boards and location stakes from damage or dislocation.

C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Section 02227 - Excavation and Backfill for Utilities.

3.04 PIPE INSTALLATION BY OPEN CUT

A. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in the following paragraphs.

B. Install pipe only after excavation is completed, the bottom of the trench fine graded, bedding material is installed, and the trench has been approved by the Owner's Representative.

C. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell hole where necessary.

D. Install pipe with the spigot ends toward the direction of flow.

E. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

F. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.

G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Owner's Representative.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

J. If a water line is encountered closer than nine feet to the proposed sewer and no special provisions are indicated on the Drawings, notify the Owner's Representative before proceeding.

K. Where the length of stubs is not indicated, install a 12-inch length and seal the free end with an approved plug.

3.05 PIPE INSTALLATION OTHER THAN OPEN CUT

A. For installation of pipe by augering, or jacking conform to requirements of specification sections on augering or jacking work as appropriate.

3.06 INSTALLATION OF APPURTENANCES

A. Service Connections. Install service connections to conform to requirements of Section 02762 - Sanitary Sewer Service Stubs or Reconnections.

B. Stacks. Construct stacks to conform to requirements of 02762 - Sanitary Sewer Service Stubs or Reconnections.

C. Construct manholes to conform to requirements of Section 02600 - Cast-in-Place Manholes, Section 02601 - Precast Concrete Manholes, as applicable. Install frames, rings and covers to conform to requirements of Section 02603 - Frames, Grates, Rings and Covers.

3.07 SEPARATION FROM WATER LINES

A. Water Line/New Sewer Line Separation - When new sanitary sewers are installed, they shall be installed no closer to waterlines than nine feet in all directions. Sewers

that parallel waterlines must be installed in separate trenches. Where the nine foot separation distance cannot be achieved, the following guidelines will apply.

1. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron, or PVC pipe meeting ASTM specifications with a pressure rating for both the pipe and joints of 150 psi. The vertical separation shall be a minimum of two feet between outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the waterline.

2. Where a sanitary sewer crosses a waterline and the sewer is constructed of cast iron, ductile iron or PVC with a minimum pressure rating of 150 psi, an absolute minimum distance of 6 inches between outside diameters shall be maintained. In addition the sewer shall be located below the waterline where possible and one length of the sewer pipe must be centered on the waterline.

3. Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe or concrete pipe with gasketed joints, a minimum two foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the waterline. This initial backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.

4. Where a sewer crosses over a waterline all portions of the sewer within nine feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at 5 feet intervals with spacers or be filled to the springline with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.

B. Waterline/Manhole Separation - Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet of horizontal clearance from an existing or proposed waterline. Where the nine foot separation distance cannot be achieved, a carrier pipe as described in subsection (A)(4) of this section may be used where appropriate.

3.08 INSPECTION AND TESTING

A. Visual Inspection. Check pipe alignment in accordance with Section 02732 - Acceptance Testing For Sanitary Sewers.

B. Mandrel Testing. Use a Mandrel Test to test flexible pipe for deflection. Refer to Section 02732 - Acceptance Testing for Sanitary Sewers.

C. Leakage Testing. After backfilling a line segment and prior to tie-in of service connections, test for leakage in accordance with Section 02732 - Acceptance Testing for Sanitary Sewers. Maintain piezometers installed to conform with Section 01563 - Control of Ground Water and Surface Water, until acceptance testing is completed.

D. Owner may elect to perform television inspection of the completed sewer before acceptance. The Contractor will be responsible for traffic control.

3.09 BACKFILL AND SITE CLEANUP

A. Backfill and compact soil in accordance with Section 02227 - Excavation and Backfill for Utilities.

B. Backfill the trench in specified lifts only after pipe installation is approved by the Owner's Representative.

C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Section 02570 - Pavement Repair and Resurfacing.

D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over the surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at a uniform slope to natural grade as indicated on the Drawings. Provide a minimum of 4 inches of topsoil as specified in Section 02920 - Topsoil and apply hydromulch according to requirements of Section 02932 - Hydromulch Seeding.

E. Provide sodding in areas of residential land use or in areas shown in plans over the surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at a uniform slope to natural grade as indicated on the Drawings. Provide a minimum of 4 inches of topsoil per Section 02920 - Topsoil. Sod disturbed areas in accordance with Section 02935 - Sodding.

F. Conform to requirements of Section 01564 - Waster Material Disposal.

END OF SECTION

SECTION 02731

SANITARY SEWER FORCE MAINS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Sanitary sewage force mains.

1.02 UNIT PRICES

A. Measurement for payment for pipe is on a unit price per linear foot basis. Measurement will be taken along the centerline of the pipe from end to end. Payment will be made per foot of force main installed, complete in place including pipe, fittings, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes and pipe, accessories, inspection and testing.

1.03 SUBMITTALS

A. Conform to requirements of all provisions and section of these specifications.

B. Submit proposed methods, equipment, materials, and sequence of operations for force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

C. Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.

D. Submit test reports as specified in Part 3 of this Section.

PART 2 P R O D U C T S

2.01 DUCTILE IRON PIPE AND FITTINGS

A. Conform to requirements of Section 02610 - Ductile Iron Pipe and Fittings.

2.02 PVC PIPE

A. Conform to requirements of Section 02620 - PVC Pipe.

B. Provide lined ductile iron fittings conforming to Section 02610 - Ductile Iron Pipe and Fittings.

2.03 POLYETHYLENE PIPE AND FITTINGS

A. Conform to requirements of Section 02619 - High Density Polyethylene (HDPE) Solid all Pipe

2.04 CENTRIFUGALLY CAST FIBERGLASS PIPE AND FITTINGS

A. Conform to requirements of Section 02618 - Centrifugally Cast Fiberglass Pipe.

2.05 THRUST RESTRAINT

A. Unless otherwise shown on the Drawings, provide concrete thrust blocking for force mains up to 12-inches in diameter, to prevent movement of buried lines under pressure at bends. Blocking shall be Portland cement concrete, as specified in Section 03305 - Concrete for Utility Construction. Place concrete in accordance with details on the Drawings. Place thrust blocks between undisturbed ground and the fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below the pipe or fitting to 12 inches above.

B. For all force mains larger than 12 inches in diameter, and where indicated on the Drawings, provide restrained joints conforming to the requirements of the force main pipe material specifications. Restrained joints shall be installed for the length of pipe on both sides of each bend or fitting for the full length shown on the Drawings.

C. Horizontal and vertical bends between zero and 10 degrees deflection angle will not require thrust blocks or harnessed or restrained joints.

D. Horizontal and vertical bends greater than 10 degrees deflection angle shall have thrust restraint as shown on the Drawings.

E. Reinforced concrete encasement of force main pipe and fittings may be used in lieu of manufactured joint restraint systems. Alternate joint restraint systems using reinforced concrete encasement shall conform to the following design requirements.

1. Design calculations shall be performed and sealed by a Professional Engineer licensed in the State of Texas.

2. Design calculations shall be based upon soil parameters quantified in the geotechnical report for the site where the alternative thrust restraint system is to be installed. If data is not available for the site, use parameters recommended by the geotechnical engineer.

3. The design system pressure shall be the specified test pressure.

4. The following safety factors shall be used in sizing the restraint system:

   a. Apply a factor of safety equal to 1.5 for passive soil resistance.

   b. Apply a factor of safety equal to 2.0 for soil friction.

5. The encasement shall be contained entirely within the standard trench width and terminate on both ends at a pipe bell or coupling.

6. Concrete encasement reinforcement steel shall be designed for all loads including internal pressure and longitudinal forces. Concrete design shall be in accordance with ACI 318.

PART 3 E X E C U T I O N

3.01 PIPE INSTALLATION BY OPEN-CUT

A. Perform excavation, bedding, and backfill in accordance with Section 02227 - Excavation and Backfill for Utilities.

B. Wrap ductile-iron pipe and fittings with polyethylene wrap in accordance with requirements of Section 02630 - Polyethylene Wrap. Polyethylene wrap shall not be installed on ductile iron pipe protected by a cathodic protection system.

C. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in the following paragraphs.

D. Install pipe only after excavation is completed, the bottom of the trench is fine graded, bedding material is installed, and the trench has been approved by the Owner’s Representative.

E. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell holes where necessary.

F. Install pipe with the spigot ends toward the direction of flow. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

G. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.

H. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where

provided. Use of backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Owner's Representative.

I. Keep excavations free of water during construction and until final inspection.

J. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

K. Where sanitary sewer force main is to be installed under an existing waterline with a separation distance of less than 2 feet, install one full joint length of pipe centered on the waterline and maintain a minimum 6-inch separation distance.

3.02 PIPE INSTALLATION OTHER THAN OPEN-CUT

A. For installation of pipe by augering or jacking conform to requirements of specification sections for augering or jacking work.

3.03 HYDROSTATIC TESTING

A. After the pipe and appurtenance have been installed, test line and drain. Prevent damage to the Work or adjacent areas. Use clean water to perform tests.

B. The Owner's Representative may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.

C. Test pipe in the presence of the Owner's Representative.

D. Test pipe at 150 psig or 1.5 times design pressure of the pipe, whichever is greater. Design pressure of the force main shall be the rated total dynamic head of the lift station pump.

E. Test pipe at the required pressure for a minimum of 2 hours according to requirements of UNI-B-3.

F. Maximum allowable leakage shall be as calculated by the following formula:

$$L = (S)\ (D)\ (P0.5) / 133{,}200$$

Where: L Leakage in gallons per hour.

S Length of pipe in feet.

D Inside diameter of pipe in inches.

P Pressure in pounds per square inch.

G. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by the Owner's Representative.

H. Plug openings in the force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering the tested pipeline.

3.04 PIGGING TEST

A. After completion of hydrostatic testing and prior to final acceptance, test force mains longer than 200 feet by pigging to ensure piping is free of obstructions.

B. Pigs: Provide proving pigs manufactured of an open-cell polyurethane foam body, without any coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to 65 percent of the nominal cross-sectional area of the pipe. Pigs shall be able to pass through standard fittings such as 45-degree and 90-degree elbows, crosses, tees, wyes, gate valves, or plug valves, as applicable to the force main being tested.

C. Test Execution: Pigging test shall be conducted in the presence of the Owner's Representative. Provide at least 48-hours notice of scheduled pigging of the force main prior to commencing the test.

END OF SECTION

SECTION 02732

ACCEPTANCE TESTING FOR SANITARY SEWERS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Acceptance testing criteria and procedures for sanitary sewers below are mandatory:

1. Visual inspection of sewer pipes.

2. Mandrel testing for flexible sewer pipes.

3. Leakage testing of sewer pipes.

4. Leakage testing of manholes.

5. Smoke testing of point repairs.

6. Post Cleaning and Television Inspection of rehabilitated sanitary sewer (See Section 02733)

B. Tests listed in this Section are required on this Project. Required test is named in other Sections which refer to this Section for testing criteria and procedures.

1.2 UNIT PRICES

A. No payment will be made for Acceptance Testing for Sanitary Sewers under this section. Payment for work performed as described under this section shall be included in the unit price bid for applicable work items.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity flow sanitary sewers are required to have a straight alignment and uniform grade between manholes.

B. Flexible pipe, including “semi-rigid” pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of a line segment but prior to final acceptance using a standard mandrel to verify that installed pipe is within specified deflection tolerances.

C. Maximum allowable leakage for infiltration or exfiltration.

1. The total exfiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of 2 feet above the crown of the pipe at the upstream manhole or 2 feet above the groundwater elevation, whichever is greater.

2. When pipes are installed more than 2 feet below the groundwater level, an infiltration test shall be used in lieu of the exfiltration test. The total infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above the crown of the pipe at the upstream manhole.

3. Refer to Table 02732-1, Water Test Allowable Leakage, at the end of this Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria are met.

D. Perform air testing in accordance with requirements of this Section and the Texas Commission on Environmental Quality requirements. Refer to Table 02732-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 02732-3, Minimum testing Times for Low Pressure Air Test, and Table 02732-4, Vacuum Test Time Table, at the end of this Section.

1.4 SUBMITTALS

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

B. Test Plan: Before testing begins and in adequate time to obtain approval through the submittal process, prepare and submit a test plan for approval by Owner's Representative Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations form the Drawings and Specifications.

C. Test Reports: Submit test reports for each test on each segment of sanitary sewer within 7 days after testing on that segment as performed.

1.5 GRAVITY SANITARY SEWER QUALITY ASSURANCE

A. Remove and replace, and retest manholes or sections of pipe which fail to meet specified requirements when tested.

B. Provide testing reports within 7 days after completion.

1.6 SEQUENCING AND SCHEDULING

A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at any one time.

B. Coordinate testing schedules with The Owner's Representative. Perform testing under observation of the Owner's Representative.

PART 2 P R O D U C T S

2.1 DEFLECTION MANDREL

A. Mandrel Sizing. The rigid mandrel shall have an outside diameter (O.D.) equal to 95 percent of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. Dimensions shall be per appropriate standard. Statistical or other "tolerance package" shall not be considered in mandrel sizing.

B. Mandrel Design. The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75 percent of the inside diameter of the pipe. The rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. A proving ring shall be provided and used for verifying each size mandrel.

C. Proving Ring. Furnish a "proving ring" with each mandrel. Fabricate the ring of 2-inch-thick, 3-inch-wide bar steel to a diameter 0.02-inches larger than approved mandrel diameter.

D. Mandrel Dimensions (5% allowance). Average inside diameter and minimum mandrel diameter are specified in Table 02732-5, Pipe vs. Mandrel Diameter, at the end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in the table may be used when approved by the Owner's Representative.

2.2 EXFILTRATION TEST

A. Test Equipment:

1. Pipe plugs.

2. Pipe risers where the manhole cone is less than 2 feet above highest point in pipe or service lead.

2.3 INFILTRATION TEST

A. Test Equipment:

1. Calibrated 90° V-notch weir.

2. Pipe plugs.

2.4 LOW PRESSURE AIR TEST

A. Minimum Requirement for Equipment:

1. Control panel.

2. Low-pressure air supply connected to control panel.

3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.

4. Air hoses from control panel to:

a. Air supply

b. Pneumatic plugs

c. Sealed line for pressuring

d. Sealed line for monitoring internal pressure

B. Testing Pneumatic Plugs: Place a pneumatic plug in each end of a length of pipe on the ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable if they remain in place against the test pressure without external aids.

2.5 GROUND WATER DETERMINATION

A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

2.6 SMOKE TESTING

A. Equipment:

1. Pneumatic plugs.

2. Smoke generator as supplied by Superior Signal Company, or an approved equal.

3. Blowers producing 2500 scfm minimum.

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.

B. The selection of test methods and pressures for gravity sanitary sewers shall be determined based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Section 01563-Control of Ground Water and Surface Water.

3.2 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

A. Check pipe alignment visually by flashing a light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

3.3 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of the line segment.

B. Pull the approved mandrel by hand through sewer sections. Replace any section of sewer not passing the mandrel. Mandrel testing is not required for stubs.

C. Retest repaired or replaced sewer sections.

3.4 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

A. Test Options:

1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.

2. Test new or rehabilitated sanitary sewer manholes with water or low-pressure air. Manholes tested with low-pressure air shall undergo a physical inspection prior to testing.

3. Leakage testing shall be performed after backfilling of a line segment, and prior to tie-in of service connections.

4. If no installed piezometer is within 500 feet of the sewer segment, Contractor shall provide a temporary piezometer for this purpose.

B. Compensating for Ground Water Pressure:

1. Where ground water exists, install a pipe nipple at the same time sewer line is placed. Use a ½ - inch capped pipe nipple approximately 10 inches long. Make the installation through manhole wall on top of the sewer line where line enters manhole.

2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect a clear plastic tube to nipple. Support tube vertically and allow water to rise in the tube. After water stops rising, measure height in feet of water over invert of the pipe. Divide this height by 2.3 feet/psi to determine the ground water pressure to be used in line testing.

C. Exfiltration test:

1. Determine ground water elevation.

2. Plug sewer in downstream manhole.

3. Plug incoming pipes in upstream manhole.

4. Install riser pipe in outgoing pipe of upstream manhole if highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.

5. Fill sewer pipe and manhole or pipe riser, if used, with water to a point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.

6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over a one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure the quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 02732-1 at the end of this section.

D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).

1. Determine ground water elevation.

2. Plug incoming pipes in upstream manhole.

3. Insert calibrated 90° V-notch weir in pipe on downstream manhole.

4. Allow water to rise and flow over weir until it stabilizes.

5. Take five readings of accumulated volume over a period of 2 hours and use average for infiltration. The average must not exceed that calculated for 2 hours from allowable leakage according to the Table 02732-1 at the end of this Section.

E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 02732-2.

1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.

2. Lines 36-inch average inside diameter and larger shall be "joint" tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during a joint test shall be 10 seconds, regardless of pipe size. "Joint Test" shall be conducted as follows:

a. Each joint shall be tested successfully.

b. Joint Tester shall be set over joint to be tested so that the two inflation tubes straddle the joint.

c. Inflate "inflation tubes" to 25 psig to seal off joint to be tested.

d. Apply air pressure into void between inflation tubes until pressure reaches 4 psig.

e. After pressure has stabilized, bleed air pressure back to 3.5 psig.

f. Record time required for pressure to drop from 3.5 psig to 2.5 psig.

g. If the time in seconds for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than 10 seconds, the joint shall be presumed to be free from defect. When the time is less than 10 seconds pipe breakage,

joint leakage or leaking tester seals are indicated and an inspection must be made to determine the cause. The contractor shall effect such repairs as may be required to accomplish a successful air joint test.

h. The joint shall be air tested before the pipe has been backfilled. Air testing shall be performed as pipe installation progresses.

3. For pipe sections less than 36-inch average inside diameter:

a. Determine ground water level.

b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.

c. After a manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.

d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in the system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 02732-2 at the end of this Section.

e. To determine air loss, measure the time interval for pressure to drop to 2.5 psig. The time must exceed that listed in the Table 02732-2 at the end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.

F. Retest: Any section of pipe which fails to meet requirements shall be repaired and retested.

3.5 TEST CRITERIA TABLES

A. Exfiltration and Infiltration Water Tests: Refer to Table 02732-1, Water Test Allowable Leakage, at the end of this Section.

B. Low Pressure Air Test:

1. Times in Table 02732-2, Time Allowed for Pressure Loss From 3.5 psig to 2.5 psig, at the end of this Section, are based on the equation from Texas Commission on Environmental Quality (TCEQ) Design Criteria 317.2(a)(4)(B).

$$T = 0.0850 (D) (K)/ (Q)$$

where:

T = time for pressure to drop 1.0 pounds per square inch gauge in seconds

K = 0.000419 DL, but not less than 1.0

D = average inside diameter in inches

L = length of line of same pipe size in feet

Q = rate of loss, 0.0015 ft^3/min./sq. ft. internal surface

2. Since a K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 02732-3, Minimum Testing Times for Low Pressure Air Test.

3. Notes:

(a). When two sizes of pipe are involved, the time shall be computed by the ratio of lengths involved.

(b). Lines with 27-inch average inside diameter and larger may be air tested at each joint.

(c). Line with an average inside diameter greater than 36 inches must be air tested for leakage at each joint.

(d). If the joint test is used, a visual inspection of the joint shall be performed immediately after testing.

(e). For joint test, the pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum times allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

3.6 LEAKAGE TESTING FOR MANHOLES

A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.

B. Plug influent and effluent lines, including service lines, with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs a minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged if lines entering manhole have not been backfilled.

C. Vacuum Testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure; do not overinflate.

2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for the time period specified in Table 02732-4, Vacuum Test Time Table.

3. If the drop in vacuum exceeds 1 inch Hg over the specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

D. Hydrostatic Exfiltration Testing: Hydrostatic exfiltration testing shall be performed as follows:

1. Seal wastewater lines coming into the manhole with an internal pipe plug. Then, fill the manhole with water and maintain it full for at least one hour.

2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot of manhole diameter per foot of manhole depth per hour.

3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3.7 SMOKE TEST PROCEDURE FOR POINT REPAIRS

A. Application: Perform smoke test to:

1. Locate points of line failure for point repair.

2. Determine if point repairs are properly made.

3. Determine if service connections have been reconnected to the rehabilitated sewer.

4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.

B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in a single manhole section at any one time. Keep the number of open excavations to a minimum.

C. Preparation: Prior to smoke testing, give written notice to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to City's Police and Fire Departments 24 hours prior to actual smoke testing.

D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal the annular space at manhole for sliplined sections.

E. Smoke Introduction:

1. Operate equipment according to manufacturer's recommendation and as approved by Owner's Representative.

2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for a minimum of 5 minutes.

3. Introduce smoke into upstream and downstream manholes as appropriate. Monitor the tap/connection for smoke leaks. Note sources of leaks.

F. Repair and Retest: Repair and replace any taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at a time. If repair or replacement, testing or retesting, and backfilling of the excavation is not completed within one workday, properly barricade and cover each excavation as approved by Owner's Representative.

G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to the newly installed liner pipe, perform a dye test to confirm reconnection. Introduce dye into the service line through a plumbing fixture inside the structure or a sewer cleanout immediately outside the structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms a reconnection.

TABLE 02732-1
WATER TEST ALLOWABLE LEAKAGE

DIAMETER OF RISER OR STACK IN INCHES	VOLUME PER INCH OF DEPTH		ALLOWANCE LEAKAGE*	
	Inch	Gallons	Pipe Size in Inches	Gallon/Minute per 100 Ft.
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	10	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value for 1" diameter.			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours.	

* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within the 25-year flood plain

TABLE 02732-2

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG

Pipe Diameter (in)	Minimum Time (min. sec)	Length for Minimum Time (ft)	Time for Longer Length (sec/ft)	Specification Time for Length (L) Shown (min. sec)										
				100 ft.	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

TABLE 02732-3

MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

PIPE DIAMETER (inches)	MINIMUM TIME (seconds)	LENGTH FOR MINIMUM TIME (feet)	TIME FOR LONGER LENGTH (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	25.856 (L)

TABLE 02732-4

VACUUM TEST TIME TABLE

DEPTH IN FEET	TIME IN SECONDS BY PIPE DIAMETER		
	48"	60"	72"
4	10	13	16
8	20	26	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
(T)	5.0	6.5	8.0

* Add T times for each additional 2-foot depth.

(The values listed above have been extrapolated from ASTM C 924-85)

TABLE 02732-5

PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size(Inches)	Average I.D. (Inches)	Minimum Mandrel Diameter
PVC-Solid (SDR 26)	6	5.764	5.476
	8	7.715	7.329
	10	9.646	9.162
PVC-Solid (SDR 35)	12	11.737	11.150
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC-Truss	8	7.750	7.363
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F 794)	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
	48	47.500	45.125
HDPE-Profile	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
	60	60.000	57.000
Fiberglass-Centrifugally Cast (Class SN	12	12.85	11.822
	18	18.66	17.727
	20	20.68	19.646
	24	24.72	23.484
	30	30.68	29.146
	36	36.74	34.903
	42	42.70	40.565
	48	48.76	46.322
	54	54.82	52.079
	60	60.38	57.361

Mandrel Test Data Sheet
City of Galveston, Texas

Date: _____ Project: _____

Material: _____ Sheet #: _____ Max Allowed Deflection: _____

Upstream MH Sta. #	Downstream MH Sta. #	Pipe Dia. (inches)	Length (feet	Pass or Fail

Inspector: _____ Date: _____

(Signature)

Contractor: _____ Date: _____

(Signature)

PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size (Inches)	Average I.D> (Inches)	Minimum Mandrel Diameter (Inches)
PVC-Solid (SDR 26)	6	5.764	5.476
	8	7.715	7.329
	10	9.646	9.162
PVC-SOLID (SDR 35)	12	11.737	11.150
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC-Truss	8	7.750	7.363
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F 794)	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
	48	47.500	45.125
HDPE-Profile	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
	60	60.000	57.000

Fiberglass-Centrifugally	12	12.850	11.822
	18	18.660	17.727
	20	20.680	19.646
	24	24.720	23.484
	30	30.680	29.146
	36	36.740	34.903
	42	42.700	40.565
	48	48.760	46.322
	54	54.820	52.079
	60	60.380	57.361

Leakage Testing for Sanitary Sewer Lines
City of Galveston, Texas

Project: _____ Sheet #: _____ Location: _____

Inspector: _____ Date: _____ Contractor: _____

Line Test Log

Test #	Manhole UP	Manhole Down	Line Length	Line Diameter	Avg. Depth of Line	Avg. Depth of Ground-water	Start Air Pressure	End Air Pressure	Time Elapsed	Time Allowed (per table*)	Pass or Fail	Inspector	Contractor
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG

Pipe Dia. (in)	Min. Time (min. sec.)	Length for Min. Time (ft)	Time for Longer Length (sec/ft)	Specification Time for Length (L) Shown (min. sec.)										
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.	500 ft.	550 ft.	600 ft.
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.419	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	157	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.7408	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.369	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

END OF SECTION

SECTION 02733

CLEANING AND TELEVISION INSPECTION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cleaning the sewer (common term for all sizes of storm and sanitary) lines to remove debris, solids, roots, sand, pieces of broken pipe, bricks, grease, and grit from all sizes of storm sewers (pipes and boxes), junction boxes, inlets, leads and trunk lines, manholes, all sizes of sanitary sewer lines (mains, services and trunk-lines), cleanouts, junction boxes, and manholes, thus improving flow and facilitating television inspection for sewer evaluation. Cleaning includes the initial washing by high-pressure water jet at storm sewers (pipes and boxes), junction boxes, inlets, leads and trunk lines, manholes, all sizes of sanitary sewer lines (mains, services and trunk-lines), cleanouts, junction boxes, and manholes.

B. Televising the line to obtain quality DVD's and TV inspection reports upon which the Owner's Representative can make a decision regarding needed cleaning, sewer rehabilitation and repair, lining or replacement by trenchless methods.

1.02 UNIT PRICES

A. Cleaning Using Normal Cleaning Equipment. Measurement for cleaning lines (pipes and boxes) with normal cleaning equipment is on a linear foot basis. The Contract unit price bid for cleaning with normal equipment is full payment for lines actually cleaned and accepted. Cleaning using normal cleaning equipment includes:

1. Charges for transient water meter setup and water usage.

2. Collection, removal, transportation, and disposal of sand, debris, and liquid wastes to legal disposal sites.

3. Locating, exposing, and opening the manholes on sewers to be cleaned.

4. The initial washing with high-pressure water hose. Payment for additional cleaning and scrubbing of manholes, inlets and junction box walls which may be required for its rehabilitation is included in the unit price for wall sealing as specified in Section 02764 Manholes, Inlets and Junction box Rehabilitation.

5. Reconstruction of manholes, inlets and junction boxes which are dismantled for access of cleaning equipment, and repair of any damages caused by the dismantling or cleaning equipment.

B. Cleaning Using Mechanical Cleaning Equipment. Measurement for cleaning sanitary sewer mains, storm sewer leads and laterals, main trunk-lines (pipes and boxes) with mechanical cleaning equipment is on a linear foot basis for the quantity approved by the Owner's Representative. The Contract unit price for cleaning sanitary and storm sewer mains, leads, laterals, pipes and boxes with mechanical cleaning equipment is paid in addition to the unit price for cleaning using normal cleaning equipment. Cleaning using mechanical cleaning equipment includes:

1. Collection, removal, transportation and disposal of sand, debris, and liquid wastes to legal disposal sites regardless of quantity of material.

2. Locating, exposing and opening the manholes, inlets and junction boxes on lines to be cleaned.

3. Reconstruction of manholes, inlets and junction boxes which are dismantled for access of cleaning equipment and repair of any damages caused by the dismantling or cleaning equipment.

C. Mechanical cleaning is limited to locations approved by the Owner's Representative on a case-by-case basis after normal cleaning methods have failed to produce satisfactory results, as determined by viewing DVDs.

1. Mechanical cleaning prior to normal cleaning does not relieve the Contractor of the responsibility of fully cleaning the pipe with normal cleaning equipment.

D. Survey TV Inspection. Measurement of survey TV inspection for pipe segments selected by the Owner's representative is on a linear foot basis from the centerline to centerline of manholes. Payment for survey TV inspection is made for the actual lengths of TV inspection footage, as measured in the field at grade as submitted for evaluation prior to final recommendations of sewer rehabilitation method.

1. No payment will be made for poor or unacceptable quality DVDs or mp4s. Hazy, unclear pictures will not qualify for payment.

2. No payment will be made for re-televising any segment without prior approval of the Owner's Representative.

3. No payment will be made for portions of lines (pipes and boxes) not televised. No payment will be made for linear feet of lines (pipes and boxes) through which the camera could not pass. Dewatering (no separate pay) if required to obtain good quality DVDs or other acceptable formats in good quality such as mp4 is subsidiary to the TV inspection.

4. No payment will be made for reverse setups required to bracket an obstruction.

5. No separate payment shall be made for line (pipes and boxes) flow control.

E. Survey TV Inspection by Floating Camera. Measurement of survey TV inspection by floating camera for pipe/box segments selected by the Owner's Representative is on a linear foot basis for actual footage televised from the centerline to centerline of manholes, junction boxes or inlets. The inspections may be required in 36-inch through 84-inch-diameter sewer pipes, small or large boxes, without any cleaning, for purely investigative studies. Payment for television inspection by floating camera shall be made based on a separate bid item for floating camera.

F. Pre-Installation TV Inspection. No separate payment will be made for pre-installation TV inspection, including cleaning, except for lines inspected but not rehabilitated. Include cost for pre-installation TV inspection in the cost of line work for which the rehabilitation effort is performed. If a line is inspected and found, in the opinion of the Owner's Representative, to require no rehabilitation work, the Contractor will be paid for pre-installation TV inspection on the basis of survey TV inspection, and cleaning on the basis of normal mechanical cleaning.

G. Post-Installation TV Inspection. No separate payment will be made for post-installation TV inspection. Include cost for post-installation TV inspection in the cost of line work for which the rehabilitation is performed. The post-installation TV inspection tape policy allows payment for work based on the field measured lengths indicated on the inspector's daily reports, but still requires the Contractor to submit a post-installation TV tape within one calendar month after the segment was completed. If no tape is received within that period, credit for the previously paid line segment will automatically be deducted from pay estimates in following months until the required tape is submitted. If , after review by the Owner's Representative, the post-installation TV tape is disapproved, the Contractor shall repair the identified defects, retelevise the entire line segment and submit a post-installation TV tape of the repaired line segment. This work shall be done at no additional cost to the Owner. If post-installation TV tape is disapproved pay may be deducted.

H. Footage paid for cleaning, under some circumstances, may exceed the footage paid for televising, as approved by the Owner's Representative.

1.03 DEFINITIONS

A. Normal Cleaning Equipment. Cleaning devices such as rods, metal pigs, porcupines, root saws, snakes, scooters, sewer balls, kites, and other approved equipment in conjunction with a hand-winching device and gas or electric rod-propelled devices. Variable pressure water nozzles, (3000 psi) are considered normal cleaning equipment.

B. Mechanical Cleaning Equipment. Buckets, scrapers, scooters, porcupines, kites, heavy-duty brushes, metal pigs, and other debris-removing equipment and accessories

used in conjunction with an approved power winching machine. High to very high-pressure water nozzels (10,000 psi) are considered as mechanical cleaning equipment.

C. Survey TV Inspection. Survey TV is a video inspection of existing pipes, boxes, leads/laterals, etc., to evaluate lines and determine if conditions exist which will require line rehabilitation.

D. Pre-Installation TV Inspection. Pre-installation TV is a video inspection by the Contractor of lines (pipes, boxes, leads/laterals) specified for rehabilitation to confirm cleaning, location of service connections, and constructability of line rehabilitation according to Drawings and Specifications.

E. Post-Installation TV Inspection. Post-installation TV is a video inspection to determine that rehabilitation of (pipes, boxes, leads/laterals) has been completed according to Drawings and Specifications.

F. TV Inspection Report. A form that is filled out by each TV inspection for any DVD that is submitted to the Owner. Form provided by the Owner's Representaive.

1.04 PERFORMANCE REQUIREMENTS

A. Clean the designated lines (pipes, boxes, leads/laterals), junction boxes, inlets, and manholes using mechanical, hydraulically propelled, or high-velocity sewer cleaning equipment. Select a cleaning process which removes grease, sand, silt, solids, marine growth, rags, and debris from each line (pipes, boxes, leads/laterals) segment and associated manholes, inlets and junction boxes.

B. The Owner's Representative may determine that no additional line rehabilitation work is required if the cleaning operation shows the line to be free of damage or deterioration. The Owner's Representative may delete from the project, any or all of the lines which do not show the need for rehabilitation.

C. If, after Pre-Installation TV Inspection, the Contractor determines that the existing line condition is such that, in his judgment, the specified rehabilitation method would be ineffective or not constructable, he should notify the Owner's Representative in writing. The Owner's Representative will determine what rehabilitation method should be used and notify the Contractor in writing.

1.05 SUBMITTALS

A. Make submittals in conformance with all provisions and sections of these specifications.

B. Submit the equipment manufacturer's operational manual and guidelines to the Owner's Representative for review. Strictly follow such instructions unless modified by the Owner's Representative.

C. Submit a list of legal disposal sites proposed for dumping debris from the cleaning operation.

D. Submit and maintain a Liquid Waste Manifest conforming to the Owner's requirements. Send the Owner's and Regulator's copies of the completed manifest to the Owner's Representative monthly.

E. Submit DVD and TV inspection reports to the Owner's Representative for review.

1. Provide DVDs of a quality sufficient for the Owner's Representative to evaluate the condition of the lines (pipes, boxes, leads/laterals), locate the leads/laterals and service connections, and verify cleaning. If quality is not sufficient, Contractor shall re-televise the Storm and Sanitary Sewer segment and provide a new tape and report at no additional cost to the Owner. Camera distortions, inadequate lighting, dirty lens, or blurred/hazy picture will be cause for rejection of a tape and rejection of the associated line segment.

2. DVDs and mp4s submitted become the property of the Owner.

3. Contractor shall maintain a master copy of all DVDs and mp4s and TV inspection reports submitted, until final acceptance of the work.

4. Transmit each TV Inspection Report to the Owner's Representative with a Transmittal Form. Copies of the TV Inspection Report form and Television Inspection Codes Summary are attached.

1.06 QUALITY ASSURANCE

A. Qualifications. Use experienced personnel to operate cleaning equipment and devices.

B. Acceptance of lines (pipes, boxes, leads/laterals) cleaning work is contingent upon the successful completion of the television inspection. If television inspection shows debris, solids, sand, grease, marine growth or grit remaining in the line, the cleaning is considered unsatisfactory. Repeat cleaning, inspection, and televising of the sewer line until cleaning is acceptable by the Owner's Representative.

C. For reporting overflow or spillage of stormwater and wastewater, refer to Section 01500 - Temporary Facilities and Controls.

PART 2 P R O D U C T S

2.01 CLEANING EQUIPMENT

A. Select the cleaning equipment and method for cleaning, based on the condition of the lines (pipes, boxes, leads/laterals) at the time work begins. More than one type of equipment or attachments may be required on a single project or at a single location.

B. When requested by the Owner's Representative, demonstrate the performance capabilities of the cleaning equipment and method proposed for use on the project. If results obtained by the demonstration are not satisfactory, provide other equipment or devices that will clean the lines (pipes, boxes, leads/laterals).

C. For cleaning equipment, install a gauge to indicate working pressure on the discharge of high-pressure water pumps. In addition to conventional nozzles, use a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18-inches and larger.

D. When cleaning equipment is used, install a suitable sand trap, weir, dam, or suction in the downstream manhole so that solids and debris and marine growth are trapped for removal.

2.02 CLEANING ACCESSORIES

A. When an additional quantity of water from the public water supply is needed to meet the cleaning requirements of the equipment and the lines (pipes, boxes, leads/laterals), obtain transient water meters from the local authority for installation on the trucks or at fire hydrants.

B. All cleaning equipment must be equipped with a backflow preventer to prevent any contamination to the public water supply.

2.03 TELEVISION EQUIPMENT

A. Closed Circuit TV Equipment. Select and use closed-circuit television equipment that will produce a color DVD and mp4.

B. Pipe Inspection Camera. Produce a DVD and mp4 using a pan-and-tilt, radial viewing, pipe inspection camera that pans ∀ 275 degrees and rotates 360 degrees. Use a camera with an accurate footage counter which displays on the monitor the exact distance of the camera from the centerline of the starting manhole, inlet, and junction box. Use a camera with camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe and box being televised. Provide a lighting system that allows the features and condition of the pipe and box to be clearly seen. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipe and box.

C. DVD. Provide DVD and mp4, recorded at Standard Play (SP).

1. Only line segments from the same basin shall be included on a DVD and mp4.

2. One or more line segments (a maximum of 5) can be included on the same DVD and mp4 as long as they are in the same basin.

3. Two labels are required. One label shall be placed on the spine of the DVD and the other on the face of the DVD and mp4 flash drive. Permanently label each DVD and mp4 flash drive with the following information:

Spine of DVD and sheet accompanying mp4 flash drive

Engineer File No.: _____ Contractor's Name: _____

Inspection Type: [ ] Survey [ ] Pre-Installation [ ] Post-Installation

DVD and mp4 No.: _____ Date Televised: _____ Date Submitted: _____

Face of Tape

Manhole No. From	Manhole No. To	Pipe Diameter	Pipe Length	Street

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Do not begin cleaning until both upstream and downstream manholes, inlets and junction boxes have been checked for flow monitors or other mechanical devices. Refer to Section 02764 - Manhole Rehabilitation.

3.02 PREPARATION

A. Cleaning.

1. Take precautions to protect lines (pipes, boxes, leads/laterals), and manholes and junction boxes and inlets from damage that might be inflicted by the improper selection of the cleaning process or improper use of the equipment. When using hydraulically propelled devices, take precautions to ensure that the water pressure created does not cause damage or flooding to public or private property. Do not surcharge the lines (pipes, boxes, leads/laterals) beyond the elevation that could cause overflow of sewage or stormwatedr into area waterways, homes, or buildings or onto the ground.

2. Do not use or obstruct a fire hydrant when there is a fire in the area. Remove water meters, fittings and piping from fire hydrants at the end of each working day.

3. Exercise care to prevent contamination of the potable water system. Use of a backflow preventer of appropriate size is mandatory when drawing water from a public hydrant.

4. Where possible, use the flow of wastewater or stormwater present in the sanitary sewer and stormwater main to provide fluid for hydraulic cleaning devices.

B. Televising. Contractor shall use the Television Inspection Report form following this section to document results of TV inspections.

3.03 CLEANING

A. Conserve Water. Do not waste water from the public water supply because of poor connections or from hydrants left opened.

B. Install Collapsible Dam. Use a collapsible dam for hydraulically propelled devices which require a head of water to operate. Provide a dam which is easily collapsible to prevent damage to the lines (pipes, boxes, leads/laterals), public property, or private property.

C. High Velocity Cleaning. Operate high-velocity cleaning equipment so that the pressurized nozzle moves continuously. Turn off or reduce the flow to the nozzle to prevent damage to the line any time the nozzle becomes stationary.

D. Mechanical Cleaning. In addition to normal cleaning equipment, perform mechanical cleaning when required and approved using equipment and accessories defined in mechanical cleaning equipment.

E. Debris Disposal. Remove sludge, dirt, sand, rocks, grease, roots, marine growth and other solid or semi-solid material resulting from the cleaning operation at the

downstream manhole, inlet and junction box of the section being cleaned. Passing debris from one line section to any other line section is not allowed. Load debris from the manholes, inlets and junction boxes into an enclosed container for liquid waste hauling. Remove and dispose of solids or semi-solids resulting from cleaning operations at the end of each workday. Do not accumulate debris, liquid waste, or sludge on the site except in totally enclosed containers approved by the Owner's Representative.

F. Disposal Sites. Dispose of waste at a legally-permitted disposal site using a transporter who has a valid TCEQ Liquid Waste Transporter Permit.

3.04 TELEVISING

A. Immediately after cleaning, televise the lines (pipes, boxes, leads/laterals) to document the condition of the line and to locate existing service connections, leads and laterals. Notify the Owner's Representative 24 hours in advance of any TV inspection so that the Owner's Representative may observe inspection operations.

B. Perform TV inspection of storm and sanitary sewers as follows:

1. Perform a survey TV inspection on any lines (pipes, boxes, leads/laterals) within the boundary of the project, as directed by the Owner's Representative. After reviewing survey TV tapes, the Owner's Representative will identify which lines (pipes, boxes, leads/laterals) will be rehabilitated or will need additional work.

2. Perform pre-installation TV inspection immediately after line cleaning and before line rehabilitation work. Pre-installation TV is not required for lines (pipes, boxes, leads/laterals) designated as "remove and replace". Verify that the line is clean and ready to accept the line rehabilitation. Prepare Television Inspection Report forms. Maintain copies of tapes and reports for reference by the Owner's Representative for the duration of the project.

3. Perform post-installation TV inspection to confirm completion of rehabilitation work, including removal and replacement. Verify that the rehabilitation work conforms to the requirements of the Drawings and Specifications. Provide a color DVD and mp4 showing the completed work, including the condition of restored service connections. Prepare and submit Television Inspection Report forms providing location of service connections along with location of any discrepancies. Manhole, inlet and junction box work, including benches, inverts and pipe penetrations into manhole, should be complete prior to post-installation TV work.

4. Videos shall pan beginning and ending manholes, inlets and junction boxes to demonstrate that all debris has been removed. Camera operator shall slowly

pan each service connection, clamped joints, and when pipe material transitions from one material to another. A TV Inspection Report shall be completed for every segment that is submitted to the Owner's Representative.

C. TV inspection tapes shall be continuous for pipe segments between manholes. Do not leave gaps in the video taping of a segment between manholes and do not show a single segment on more than one DVD and mp4, unless specifically allowed by the Owner's Representative.

3.05 FLOW CONTROL

A. Perform survey TV inspection on one manhole section at a time. Adequately control the flow in the section being televised. Do not exceed the depth of wastewater flow shown below:

Pipe Diameter inches/Box cross sectional area sq. ft. (Inches)	Depth of Flow (Percent of Pipe Diameter/box height)
6 to 10/0.5 to 1	10
12 to 24/1 to 4	15
Over 24/over 4	20

1. If during survey TV inspection of a manhole section, the wastewater or stormwater flow depth exceeds the maximum allowable, reduce the flow depth to an acceptable level by performing the survey TV inspection during minimum flow hours, by diversion pumping, or by pulling a camera with swab, high-velocity jet nozzle or other acceptable dewatering device. DVD made while floating the camera is not acceptable unless approved by the Owner's Representative.

B. Minimize flow in the line while performing pre-installation TV inspection. Divert the normal flow and clean the line to be inspected.

C. No flow is allowed in the line while performing post-installation TV inspection.

3.06 PASSAGE OF TV CAMERA

A. Do not pull or propel the television camera through the line at a speed greater than 30 feet per minute.

B. If during survey TV inspection of a manhole, junction box and inlet section, the camera is unable to pass an obstruction even though flow is unobstructed, televise the manhole, junction box and inlet section from the other direction (reverse setup) in order to obtain a complete video of the line. Whenever such a condition arises, notify the Owner's Representative to determine if an obstruction removal or point repair is necessary. If a point repair is authorized, repair the pipe and box at the designated location and then re-televise the manhole, inlet and junction box section to verify completion of the point repair, unless waived by the Owner's Representative.

1. When the camera is being pulled from the other direction in order to survey on either side of an obstruction and a second repair location is encountered away from the first obstruction, notify the Owner's Representative and request a review of the TV tape. The Owner's Representative may direct the Contractor to make one or both point repairs. No downtime shall be allowed.

2. If two point repairs are allowed and completed, re-televise the manhole section. Generally, up to 20 feet of the lines (pipes, boxes, leads/laterals) from the finished end of the first point repair to the starting end of the second point repair may be lamped or physically inspected to verify the condition of the sewer without further TV inspection.

3. The Owner makes no guarantee that the lines (pipes, boxes, leads/laterals) specified or proposed for survey TV after cleaning, is clear for the passage of the camera set-up. Select the appropriate equipment, tools, and methods for securing safe passage of the camera.

C. During pre-installation TV inspection, camera passage should show the line is ready to rehabilitate. Report any variations between previous reported (existing data) conditions and the actual conditions encountered to the Owner's Representative.

D. For post-installation TV inspection, exercise the full capabilities of the camera equipment to document the completion of the rehabilitation work and the conformance of the work to the Drawings and Specifications. Provide a full 360-degree view of pipe, joints and service connections.

3.07 TV INSPECTION REPORT

A. For each TV inspection video provide a completed TV Inspection Report, as attached at the end of this section. The Report is a written/narrated log of pipe defects, sags, service connection locations and conditions, indexed to the footage counter. The TV Inspection Report shall be filled out as instructed below.

B. Direction of Flow

1. MANHOLE/INLET/JUNCTION BOX NUMBER: The upstream manhole number of the line segment shall be put in this field. This is an alphanumeric field with 9 spaces available (i.e. SB179003).

2. MANHOLE/INLET/JUNCTION BOX NUMBER: The downstream manhole number of the line segment shall be put in this field. This is an alphanumeric field with 9 spaces available (i.e. SB179002).

C. Header Section

1. ADDRESS UPS/DWN: The upstream and downstream address of the line segment shall be put in this field. This is an alphanumeric field with 6 spaces available for the street number and 21 spaces available for the street name (i.e., UPS: 2150 Sunnyland DWN: 2110 Sunnyland).

2. W.W. FILE NO.: The Owner's Representative's File number shall be put in this field. This number is found on the contract documents and specifications. This is an alphanumeric field with 10 spaces available (i.e., 4250-49).

3. WORK ORDER NO.: This number will be provided by the Owner, this field shall be left blank. This is a numeric field with 10 spaces available.

4. TV DATE: The date that the DVD was produced shall be placed in this field. This date shall be the same as the date shown on the display screen. This is a numeric field with 8 spaces available (i.e., 2/21/95).

5. BASIN: The basin that the line segment is located in shall be placed in this field. This is an alphanumeric field with 10 spaces available (i.e., IA010).

6. TV CONTRACTOR: The TV Contractor's name shall be placed in this field. This is an alphanumeric field with 5 spaces available.

7. WEATHER: The existing weather conditions at the time that the TV tape was made shall be placed in this field. This is an alpha-numeric field with 10 spaces available (i.e., Cloudy)

8. VTR FORMAT: The VTR format shall be placed in this field. This is an alphanumeric field with 4 spaces available (i.e., VHS).

9. TAPE NUMBER: Each TV tape produced must have a tape number for identification. This number must be affixed to the cassette label. This number must not be duplicated in the same project. This is an alphanumeric field with 6 spaces available (i.e., IA0101).

10. VTR INDEX: The numeric location of the line segment on the tape shall be indicated here. This is an alphanumeric field with 6 spaces available for each number (i.e., 1336 to 2185).

11. SUMMARY:

    a. This line is to be used to put in additional information about the line segment as indicated below:

    b. Type of TV Tape (i.e., Post, Survey, Pre-Rehabilitation)

        (1). General Contractor (i.e., Cullum, Kinsel, Texas Sterling)

        (2). Rehabilitation Method (i.e., FF, CPP, PB, SL, RR)

        (3). Rehabilitation System Manufacturer or Trade Name when applicable (i.e., Insituform, Inliner II)

        (4). PIM System, McConnell Pipe Crushing, U Liner)

        (5). Pipe Trade Name for PVC, PEP or FRP pipe (i.e., Hobas, Drisco 1000, Lamson Vylon, Quail)

    c. This information will be noted in the following manner:

        (1). Post/Cullum/FF/U Liner/Quail (a typical listing for a **Fold and Form** line segment)

        (2). Post/Insituform/CPP/Insituform (a typical listing for a **Cured-in-Place** line segment)

        (3). Post/McLat/PB/McConnell PipeCrushing/Drisco1000 (a typical listing for a **Pipeburst** line segment)

        (4). Post/Kinsel/SL/Hobas (a typical listing for a **Sliplined** line segment)

        (5). Post/Texas Sterling/RR/Lamson Vylon (a typical listing for a **Removed and Replaced** line segment)

12. LOCATION: The physical location of the line segment shall be placed in this field. The location is for the line segment, not the manholes. If the line segment covers more than one location, then choose location where majority of line segment is. The codes for the location are shown on the attached Television Inspection Codes list. This is an alpha-numeric field with 2 spaces available (i.e., C)

13. SURFACE COVER: The type of surface that covers the line segment shall be placed in this field. Use the designation that reflects what covers the majority of the line segment. The codes for surface cover are shown on the attached Television Inspection Codes list. This is an alpha field with only 1 space available (i.e., F).

14. PIPE SIZE: The inside diameter of the liner or pipe based on new pipe size, material and SDR shall be placed in this field. The unit of measure is inch. This is a numeric field with 6 spaces available, which includes 2 spaces for decimals (i.e., 6.58 IN).

15. PIPE TYPE: The pipe or liner type installed shall be placed in this field. This is an alpha field with 3 spaces available (i.e., PEP, CPP, PVC).

16. LENGTH: The length of the line segment shall be placed in this field. The length shown on the TV report shall be the same as the length shown on the DVD. Also, the length on the top portion of the TV report shall match that shown on the bottom portion of the TV Report. The unit of measure is feet. This is a numeric field with 4 spaces available, with no decimals (i.e., 305 FT).

17. UPS DEPTH: The depth, measured from the top ring of the upstream manhole to the invert of the upstream manhole, shall be placed in this field. The unit of measure is in feet and tenths of feet. This is a numeric field with 3 spaces available, which includes one space for a decimal (i.e., 6.9 FT).

18. DWN DEPTH: The depth, measured from the top ring of the downstream manhole to the invert of the downstream manhole, shall be placed in this field. The unit of measure is in feet and tenths of feet. This is a numeric field with 3 spaces available, which includes one space for a decimal (i.e., 7.4 FT).

19. JOINT LENGTH: The pipe joint length shall be placed in this field. Show no joint length for CPP, FF and PEP line segments. Put a "0" in the field for these line segments that have no joints. The unit of measure is inch. This is a alpha field with 2 spaces available (i.e., 40 IN).

20. FLOW DEPTH: The pipe or liner flow depth shall be placed in this field. The unit of measure is inch. This is a numeric field with 3 spaces available, which includes one decimal place (i.e., 2.5 IN).

21. MASTER DVD NO. : The Contractor's master DVD and mp4 number (if one exists) shall be placed in this space. This item is not in the database, therefore there is no field length or type data for this item.

22. REVERSE SET UP: When a reverse set up is done on a line segment check "yes" if not check "no". This item is not in the database, therefore there is no field length or type data for this item.

23. SKETCH: If a sketch of the line segment is included check "yes" if not check "no". This item is not in the database, therefore there is no field length or type data for this item.

24. PRIOR HISTORY: If any prior information exists on this line segment check "yes" if not check "no". This item is not in the database, therefore there is no field length or type data for this item.

25. EVALUATION TV: If the TV Inspection Report is for line segment evaluation or survey purposes check "yes" if not check "no". This item is not in the database, therefore there is no field length or type data for this item.

26. PRE-REHAB TV: If the TV Inspection Report is for pre-installation TV inspection to show that the line is ready for rehabilitation check "yes" if not check "no". This item is not in the database, therefore there is no field length or type data for this item.

27. POST-REHAB TV: If the TV Inspection Report is for post-rehab TV inspection to document the completion of the rehabilitation work check "yes" if not check "no". This item is not in the database, therefore there is no field length or type data for this item.

28. LINE DETERIORATION: The existence of pipe deterioration and how much deterioration exists shall be indicated here. If there is no deterioration check "N" if deterioration is light check "L", if it is medium check "M", if it is heavy check "H". This item is not in the database, therefore there is no field length or type data for this item.

29. DIRECTION OF FLOW: The direction of flow in the line segment shall be placed in this field. Typically, the larger number is the upstream manhole and the smaller number is the downstream manhole, inlet and junction box. Do not reverse the manhole, inlets and junction box designation on the TV report if a reverse set up is shown, check the reverse set up box on the report.

D. CODE INPUT SECTION

1. TV INSPECTION CODES: Codes to be used in this section are shown on the Television Inspection Codes sheet (attached).

2. FOOT READ U/D: The up/down designation shall be shown under the section titled "Footage Reading" in the boxes marked "U." and "D." This will make it clear what direction footage is measured from.

3. CLOCK POSITION: The clock position, with 12 o'clock straight up, of each defect shall be shown in this field (i.e., 12:00, 3:00). Also, show the clock position of each service connection and state the condition of the connection. Include the distance the connection is protruding into the pipe and box, when appropriate, and the type of connection, such as plumber service.

4. CRACKS: Any cracks in the pipe shall be listed in this field using the codes on the Television Inspection Codes sheet. Report the size length and width of any cracks.

5. JOINTS: Misaligned and broken joints shall be listed in this field using the codes on the Television Inspection Codes sheet.

6. LATERALS: All laterals shall be listed in this field using the codes on the Television Inspection Codes sheet.

7. ROOTS: Any root intrusion into the pipe and box shall be listed in this field using the codes on the Television Inspection Codes sheet.

8. DEBRIS: Any debris in the pipe and box shall be listed in this field using the codes on the Television Inspection Codes sheet.

9. INFLOW/INFILTRATION: Report any inflow and infiltration in this field using the codes listed on the Television Inspection Codes sheet.

10. ALIGNMENT: Report the existence of any sags in the field using the codes listed on the Television Inspection Codes sheet. Report the beginning of sags for one-quarter pipe, one-half pipe and underwater as well as where the camera pulls out of the sag.

11. STRUCTURAL: Report structural condition of the pipe using the codes listed on the Television Inspection Codes sheet.

12. PICTURE NO.: Leave this field blank.

13. COMMENTS: Comments shall be placed in this field. Comments must be accompanied by a corresponding footage. Items to report in this field are: collapses in pipe, stabilized material, mineral deposits, changes in pipe material, reverse set up, drop stack, large voids, multiple cracks, when unable to continue video, etc.

14. CLAMP/SPLICE LOCATION: The clamp/splice location shall be shown in the Comments field. Clamp/splice location must be accompanied by a footage.

15. START SURVEY AT M. H. XYZ: The depth of the line segment shall be shown in the Comments field. (i.e., Start Survey at M. H. 021 - Line Depth 10.2 FT). The depth is to be measured from the top ring of the manhole to the invert of the pipe being televised. The unit of measure is feet and tenths of feet. This depth may be different from the manhole depth.

16. END OF SURVEY AT M. H. XYZ: The depth of the line segment shall be shown in the comments field (i.e., End Survey at M. H. 022 - Line Depth 10.8 FT). The depth is to be measured from the top ring of the manhole to the invert of the pipe being televised. The unit of measure is feet and tenths of feet. This depth may be different from the manhole and junction box depth.

3.08 FIELD QUALITY CONTROL

A. Do not allow, under any circumstances, sewage or solids removed in the cleaning process to be released onto streets or into ditches, catch basins, storm drains, sanitary or storm sewer manholes, or cleanouts.

B. Acceptance of lines (pipes, boxes, leads/laterals) cleaning work is contingent upon the successful completion of the television inspection. If the television inspection shows debris, solids, sand, grease, or grit remaining in the line, the cleaning will be considered unsatisfactory. Repeat cleaning, inspection, and televising of the lines (pipes, boxes, leads/laterals) line until cleaning is satisfactory.

3.09 ADJUSTING

A. Repair manholes, junction boxes and inlets which are dismantled or damaged during the cleaning process and replace any manhole frame and cover which is damaged during the cleaning process.

TABLE 02733A

TELEVISON INSPECTION CODES

HEADER INFORMATION

LOCATION

A	STREET ROW, HEAVY TRAFFIC
B	STREET ROW, LIGHT TRAFFIC
C	EASEMENT, POOR ACCESS
D	EASEMENT, GOOD ACCESS
E	PARKING LOT, POOR ACCESS
F	PARKING LOT, GOOD ACCESS
G	ALLEY, POOR ACCESS
H	ALLEY, GOOD ACCESS
I	OPEN AREA, POOR ACCESS
J	OPEN AREA, GOOD ACCESS

SURFACE COVER

A	ASPHALT STREET
B	CONCRETE STREET
C	SHELL STREET
D	SIDEWALK
E	TREES/SHRUBS
F	CLOSE TO FENCE
G	OPEN AREA
H	MOVABLE BUILDING
I	UNMOVABLE BUILDING
J	OVERHEAD UTILITIES
K	WATERWAY OR RAILWAY
L	HIGHWAY OR RUNWAY
M	PIPE ABOVE GROUND

PIPE TYPE

ABS	ACRYLONITRILE BUTADIENE STYRENE
BRK	BRICK
CIP	CAST IRON PIPE
CMP	CORRUGATED METAL PIPE
CON	POURED IN PLACE CONCRETE

JOINTS

MJ – MISALIGNED JOINT BJ – BROKEN JOINT

CODES	DESCRIPTION	USE IN
A (3)	DRP JT > 90% CLEAR	MJ
B (6)	DRP JT 80 – 90% CLEAR	MJ
C (9)	DRP JT < 80% CLEAR	MJ
D (3)	SHF JT > 90% CLEAR	MJ
E (6)	SHF JT 80 – 90% CLEAR	MJ
F (9)	SHF JT < 80% CLEAR	MJ
G (1)	WD JT 2″ – 3″	MJ
H (2)	WD JT 3″ – 4″	MJ
I (3)	WD JT > 4″	MJ
J (2)	BRK JT – LIGHT	BJ
K (4)	BRK JT – MEDIUM	BJ
L (6)	BRK JT – HEAVY	BJ
N (0)	VISIBLE GASKET	MJ
O (0)	LEAKING AT JOINT	MJ

LATERALS (L)

CODES	DESCRIPTION
A (1)	PRT SER 0″ – 1″
B (2)	PRT SER 1″ – 2″
C (3)	PRT SER 2″ – 3″
D (4)	PRT SER 3″ +
E (5)	DEFECTIVE – SERVICE CONN.
F (6)	DEAD/UNUSED SERVICE
G (7)	FACTORY SERVICE
H (0)	PLUMBER SERVICE

ROOTS (R)

CODES	DESCRIPTION
A (1)	ROOTS – LIGHT
B (2)	ROOTS – MEDIUM
C (3)	ROOTS – HEAVY

CPP	CURED IN PLACE PIPE
DIP	DUCTILE IRON PIPE
FRP	FIRBERGLASS REINFORCED PIPE
PLP	PLASTIC LINED CONCRETE PIPE
PEP	POLYETHYLENE PIPE
PVC	POLYVINYLCHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
RPM	REINFORCED PLASTIC MORTAR PIPE
URC	UNREINFORCED CONCRETE PIPE
VCP	VITRIFIED CLAY PIPE

WEATHER

DRY - WET

CODE DESCRIPTIONS

CRACKS

RC-RADICAL LC-LONGITUDINAL

CODES	DESCRIPTION	USE IN
A (1)	<1/2" W, < 1' L	CRK
B (2)	<1/2" W, 1' – 2' L	CRK
C (3)	<1/2" W, > 2' L	CRK
D (4)	>1/2" W, < 1' L	CRK
E (5)	>1/2" W, 1' – 2' L	CRK
F (6)	>1/2" W, > 2' L	CRK
G (7)	HOLE IN PIPE – SMALL	
H (8)	PIPE MISSING - < 60°	
I (9)	PIPE MISSING - > 60°	

DEBRIS (D)

CODES	DESCRIPTION
A	DEBRIS – LIGHT
B	DEBRIS – MEDIUM
C	DRBRIS – HEAVY
D	GREASE – LIGHT
E	GREASE – MEDIUM
F	GREASE – HEAVY

INFLOW/INFILTRATION (I)

CODES	DESCRIPTION
A (3)	I/I – LIGHT (0-1 GPM)
B (6)	I/I – MEDIUM (1-5 GPM)
C (9)	I/I – HEAVY (>5 GPM)
D (2)	I/I – SOME EVIDENCE
E (4)	I/I – CONSIDERABLE EVIDENCE
F (6)	I/I – GREAT EVIDENCE
G (0)	I/I – NO EVIDENCE

ALIGNMENT (A)

CODES	DESCRIPTION
A	BEGIN 1/4 PIPE WATER
B	BEGIN 1/2 PIPE WATER
C	CAMERA UNDERWATER
D	END CAMERA UNDERWATER
E	END 1/2 PIPE WATER
F	END 1/4 PIPE WATER

STRUCTURAL

DS – DETERIORATED; OS – OVALITY; CS - COLLAPSED

CODES	DESCRIPTION	USE IN
A (3)	LINE DET – LIGHT	DS
B (6)	LINE DET – MEDIUM	DS
C (9)	LINE DET – HEAVY	DS
D (3)	OVAL < 5%	OS
E (6)	OVAL > 5% & < 10%	OS
F (9)	OVAL > 10%	OS
G (9)	COLLAPSED	CS
H (0)	PIPE DET – HEAVY	DS

L (0)	PIPE DET – LIGHT	DS
M (0)	PIPE DET – MEDIUM	DS
N (0)	PIPE DET – NONE	DS
O	LINE DET – NONE	DS
Z (0)	AT MANHOLE NUMBER	CS

NOTE:
REPLACE PIPE WITH BOX AS NEEDED

END OF SECTION

SECTION 02761

SLIPLINING SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Sliplining existing sanitary sewers.

1.02 UNIT PRICES

A. Measurement for sliplining is on a linear foot basis for installed liner, measured along the center line of the pipe for each size and wall thickness at each installed depth range and measured from center line of upstream manhole to center line of downstream manhole. Depth range for payment shall be based on the depth of the lowest manhole for a given pipeline segment between two adjacent manholes.

B. Insertion or access pits, clamp installation, encasement, field quality control (testing), sealing liner at manhole, grouting annular space, post-televising of completed work, and final cleanup shall be incidental to installation of sliplining.

C. Measurement and payment for diversion pumping is incidental.

D. Obstruction removal may be effected as a point repair if approved in advance by Owner's Representative. Refer to Section 02763 - Point Repairs to Sanitary Sewers for measurement of point repairs.

E. Measurement for obstruction removal by remote device is on a unit price basis for each removal operation for one or more manhole sections up to a continuous length of 800 feet.

1.03 PERFORMANCE REQUIREMENTS

A. Maintain flow of sewage by diversion pumping or other method approved by the Owner's Representative.

B. Clear existing sewer of debris, obstructions, or other material and make point repairs to existing sewers as specified in Section 02763 - Point Repairs to Sanitary Sewers.

C. Install sliplining according to this Section.

D. Grout annular space as specified in Section 02331 - Sliplining Grout.

E. Shape manhole invert as specified in Section 02764 - Manhole Rehabilitation.

F. Test and televise lines as specified in Section 02732 - Acceptance Testing of Sanitary Sewers.

1.04 SUBMITTALS

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

B. Submit manufacturer's product data with complete information on pipeline materials, physical properties, and dimensions pertinent to this job. Furnish a certificate of compliance with specifications for materials to be supplied.

C. Submit test reports prepared by an independent testing laboratory certifying that polyethylene pipe conforms to the requirements of ASTM D1248 and ASTM D3350 or that FRP pipe conforms to requirements of ASTM D2992 and ASTM D3681, as applicable.

D. Submit grouting plan showing where grout is to be injected, materials, and chemicals to be used in grout, anchoring methods, and planned grouting pressure.

E. Submit DVD’s at standard play showing the initial condition of sewer, if needed, and tapes showing completed installations.

F. Submit a Quality Control Program defining Contractor's and material supplier's field quality control procedures. Owner’s Representative may request evidence that work is progressing or has been done in compliance with the submitted quality control program.

1.05 TESTING

A. The Owner may run tests on field samples following applicable ASTM specifications at an independent laboratory to verify the required physical properties and characteristics of supplied materials. Provide product samples as requested by Owner’s Representative.

B. The Owner will pay for tests on liner material which meets specification requirements. Contractor shall pay for failed tests and retesting of failed materials.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. Liner pipe systems shall be polyethylene or fiberglass reinforced plastic (FRP) products as approved by the City.

B. Polyethylene liner manufacturers shall be Chevron Phillips, or approved equal. FRP liner manufacturer shall be Hobas USA, Inc., or approved equal.

2.02 POLYETHYLENE LINER PIPE AND FITTINGS

A. The polyethylene liner pipe shall be solid wall, high density, high molecular weight, polyethylene compound conforming to ASTM D1248, Type III, Class C, Grade P-34, Category 5, with a PPI rating of PE 3408. The polyethylene material shall have a minimum cell classification of 3454 34D or E (inner wall shall be light in color) under ASTM D3350. A higher numbered cell classification limit which gives a desirable higher primary property, according to ASTM D3350, is also acceptable. Hydrostatic design value shall not be less than 1600 psi when tested according to ASTM D2837. Dimensions and workmanship shall be in accordance with ASTM F714 and ASTM D2122.

B. The maximum Standard Dimension Ratio (SDR), the ratio of outside diameter of pipe to wall thickness, shall be as specified below. SDR shall be selected for the deeper of the two manholes in a particular pipeline segment between two adjacent manholes.

Maximum Liner SDR	Maximum Depth (Feet)
26	10
21	15
19	20
17	Over 20

C. Minimum outside diameter of liner shall be as shown in the following table:

Existing Sewer Nominal Diameter (Inches)	Minimum O.D. Of Liner (Inches)
8	7.125

10	8.625
12	10.75
15	12.75
18	16.00
21	18.00
24	22.00
27	24.00
30	28.00
36	32.00
42	36.00
48	42.00

D. Liner Acceptance: Liner material shall be homogeneous without defects and shall be manufactured to the standards and dimensions specified. Cause for rejection includes physical defects of the polyethylene liner, such as concentrated ridges, discoloration, excessive spot roughness, pitting, visible cracks, foreign inclusions, and varying wall thickness.

2.03 FRP LINER PIPE AND FITTINGS

A. All pipe, joints, and fittings shall conform to the requirements of ASTM D3262, Type 1, Liner 2, Grade 3. Pipe shall be manufactured by the centrifugal casting process resulting in a dense, nonporous, corrosion resistant, consistent, composite structure to meet conditions as shown on Drawings.

B. Resin systems shall be thermosetting polyester epoxy resin, with or without filler, producing a pipe conforming to requirements of ASTM D3262.

C. Reinforcing glass fibers shall be commercial grade, E-type glass filaments with binder and sizing compatible with impregnating resins.

D. Filler shall be sand with a minimum 98 percent silica content and a maximum moisture content of 0.2 percent.

E. Joints shall be low-profile FRP jacking bell-and-spigot joints with elastomeric sealing gaskets to produce watertight joint. Joints shall conform to the requirements of ASTM D4161.

F. Dimensions and Tolerances:

1. Pipe outside diameters shall be in accordance with AWWA C151.

2. Supply pipe in nominal lengths of 20 feet, when possible. Where radius curves in existing pipe or limitations in entry pit dimensions restrict pipe to shorter lengths, use nominal sections of 10 feet or 6.67 feet. Actual laying length shall be the nominal length plus 2 inches. Furnish at least 90 percent of total footage of each size and class of pipe, excluding special order lengths, in nominal length sections.

3. The FRP pipe maximum outside diameter and minimum wall thickness shall be as specified in the following table:

Minimum Existing Sewer Nominal Diameter (Inches)	Minimum Liner O.D. (Inches)	Minimum CL SN46 Wall Thickness (Inches)	CL SN72 Wall Thickness (Inches)
21	19.50	0.42	0.48
24	21.60	0.46	0.53
30	25.80	0.54	0.63
36	32.00	0.66	0.77
42	38.30	0.78	0.91
48	44.50	0.90	1.05
54	50.80	1.02	1.19
60	57.10	1.14	1.33
66	62.90	1.26	1.47
72	69.20	1.38	1.61

78	75.40	1.50	1.75

4. Fabricate pipe ends square to pipe axis plus or minus 0.25 inches, or plus or minus 0.5 percent of nominal diameter, whichever is greater.

G. Flanges and Fittings:

1. Flanges, elbows, reducers, tees, wyes, and other fittings shall be capable of withstanding operating conditions. Fittings shall be contact-molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays.

2. Manufacture the angle of an elbow and angle between main and leg of a wye or tee to a tolerance of plus or minus 2 degrees. Maintain a tolerance on laying length of a fitting to plus or minus 2 inches.

H. FRP pipe shall have a minimum stiffness of 46 psi measured in accordance with ASTM D2412. Pipes with a stiffness class of 72 psi may be used with approval of Owner's Representative.

2.04 MANHOLE SEAL

A. A manhole seal between liner pipe and existing host sewer shall be formed with oakum strips soaked in Scotchseal 5600 as manufactured by 3M Corporation, or an approved equal.

2.05 CLAMPS AND GASKETS

A. Clamps shall be stainless steel, including bolts and lugs as manufactured by JCM Industries, Type 108. Furnish full circle, universal clamp couplings with 1/4-inch thick grid gasket. Select clamps to fit outside diameter of liner pipe. Use minimum clamp width as specified in the following table:

Linear Pipe O.D. (Inches)	Minimum Width Of Clamp (Inches)
7.125	15
8.625	18

10.750 or greater	30

2.06 BEDDING MATERIAL

A. Provide bedding conforming to requirements of Section 02229 - Utility Backfill Material and Section 02252 - Cement Stabilized Sand.

PART 3 E X E C U T I O N

3.01 DELIVERY, STORAGE, AND HANDLING

A. Prevent injury or abrasion to pipe during loading, transportation, and unloading. Do not drop pipe from cars or trucks, nor allow pipe to roll down skids without proper restraining ropes. Use suitable pads, strips, skids, or blocks for each pipe during transportation and while awaiting installation in the field.

B. Pipe with cuts, gashes, nicks, abrasions, or any such physical damage which may have occurred during shipping, storage, or handling, which are deeper than 10 percent of the wall thickness shall not be used and shall be removed from the construction site.

3.02 OBSTRUCTION REMOVAL AND POINT REPAIR

A. Make point repairs and remove obstructions such as roots, rocks or other debris, prior to installing liner pipe. Debris shall be removed and disposed of in accordance with Section 01564 - Waste Material Disposal. Water jetting of debris downstream of project limits shall not be permitted.

B. Refer to Section 02763 - Point Repairs to Sanitary Sewers for requirement and procedures for point repairs.

C. Obstruction removal may be effected as a point repair or by use of a remote device. For removal by remote device, obtain prior approval of Owner's Representative.

D. To remove obstructions by remote device, use a solid steel mandrel or porcupine mandrels winched from one manhole to another. Use mandrels of adequate size to remove obstructions encountered. Use of bucket machines to break obstruction is acceptable if no damage to sewer pipe is caused.

3.03 DIVERSION PUMPING

A. Install and operate diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Owner's Representative.

B. Design all piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify Owner's Representative so that required reporting can be made to the Texas Committee on Environmental Quality and Environmental Protection Agency.

3.04 INSERTION OR ACCESS PITS

A. Locate pits so that the total number is minimized and footage of liner pipe installed in a single pull is maximized. Use excavations at point repair locations for insertion pits, where possible.

B. Before excavating, check with various utility companies and determine the location of utilities in the vicinity of the work area. Arrange for temporary construction easements and rights-of-way. Damage done to utilities and the resulting repair, temporary service, and other such costs shall be borne by Contractor.

C. Perform excavation and backfill in accordance with requirements of Section 02227 - Excavation and Backfill for Utilities.

D. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 - Trench Safety System for excavations over 5 feet deep.

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.

3.05 TESTING OF HOST SEWER

A. The Contractor shall provide a rigid, solid wall, cylindrical mandrel with a maximum length equivalent to two times the host sewer inside diameter and outer diameter 1.5-inch larger than the actual sliplining pipe. The Contractor shall pull this mandrel through the entire length of sewer to be sliplined prior to liner insertion in order to test the inside diameter of the host pipe, to locate undersized or obstructed sections of the host sewer, and as a method of removing accumulated debris.

B. If a section of host pipe is discovered which will not allow the mandrel to pass, the Contractor shall record the physical position of the mandrel and removed it from the

sewer. He shall then insert the mandrel from the other end of the section and record the position at which it will not pass. This will define both ends of the undersized section of host sewer.

C. The Contractor shall excavate the undersized portion of the host sewer as located above, remove the crown of the host sewer, and enlarge the host sewer sufficiently to allow the liner to be laid in the half section (invert to springline) of the host sewer with the liner pipe resting fully on the invert of the host sewer.

D. The liner shall be bedded and backfill in accordance with Section 02227 - Excavation and Backfill for Utilities.

3.06 POLYETHYLENE LINER INSTALLATION

A. Preparation: After completing insertion pit excavation, remove top of existing sanitary sewer line down to the spring line. Connect a power winch cable to the end of liner by use of a suitable pulling head equal to the outside diameter of liner. Secure pulling head to liner and attach to power winch cable so that liner can be satisfactorily fed and pulled through sanitary sewer main. Provide proper bumpers in insertion pit to prevent ragged edges of existing pipe from scarring liner pipe. Refer to insertion procedures given in ASTM F585. Do not allow sand or other debris to enter the liner.

B. Joints:

1. Assemble and joint sections of polyethylene liner pipe on site above the ground. Make joints by heating and butt-fusion method in strict conformance with manufacturer's instructions.

2. Use operators who are experienced with the butt-fusion method for pipe jointing in the field. Operators should be trained in fusing polyethylene pipe with similar equipment using proper jigs and tools per standard procedures outlined by pipe manufacturer.

3. Form joints with a smooth, uniform double rolled back bead made while applying the proper melt, pressure, and alignment. Joints shall be inspected by Owner’s Representative before insertion.

4. The maximum length of continuous liner which may be assembled above ground and pulled at any one time is 500 linear feet. Limit length of liner pulled in any one segment to prevent backup in service lines which may result due to restricted flow through the annular space.

5. Prevent damage to liner or breakage of butt-fused joints. Allow sufficient time for liner to return to its normal length.

C. Pulling Liner:

1. Limit pulling force exerted on liner to that indicated below for the appropriate outside diameter of the polyethylene liner:

Polyethylene Liner O.D. (Inches)	Maximum Pulling Force (Tons)
6	3.5
8	4.0
10	7.5
12	10.5
15	12.0
18	21.5
21	35.0
24	52.0

2. Use a suitable pulling head so that pulling head and liner will separate from each other when pulling force exerted on liner reaches the specified amount.

3. As an alternate, use of a measuring device, such as a spring gauge, will be permitted when approved in advance by the Owner's Representative. Connect the device to pulling cable so that it registers the pulling force being exerted on liner. Do not exceed pulling force indicated above for applicable outside diameter of polyethylene liner.

D. Alternate Installation Techniques. Pushing the liner as an insertion method, or a combination of pulling and pushing, may be used subject to Owner's Representative's approval. Avoid liner buckling by limiting the stroke of the pushing implement. Cut out and remove any portion damaged during insertion process.

3.07 FRP PIPE INSTALLATION

A. FRP liner pipes may be pushed or pulled into the existing sewer. Insert the pipes, spigot end first, with the bell end trailing. Apply pushing force to pipe wall end inside of bell in accordance with manufacturer's instructions. Do not apply a jacking load to end of bell. Keep within safe jacking loads given in the following table. Maximum allowable joint angular deflection shall be 1.0 degree:

Nominal Diameter (Inches)	Maximum Jacking Load (Tons) For SN46
18	16
20	20
24	30
30	42
36	50
42	65
48	80
54	100
60	120
66	140
72	160

3.08 CLAMP INSTALLATION

A. Where excavations for liner insertion are made between two manholes, cut ends of the liner smooth, square to axis of the liner. Join liners with appropriately sized stainless steel universal clamp couplings.

3.09 ENCASEMENT

A. In excavations where liner is not enclosed by existing host sewer, encase liner with stabilized cement sand bedding conforming to requirements of Section 02252 - Cement Stabilized Sand. Visual inspection by Owner's Representative is required for approval of bedding before backfill is completed.

3.10 FIELD QUALITY CONTROL

A. After liner installation, perform the following tests:

1. Low-pressure air test before liner has been sealed in place at the manholes, and before any service reconnections have been made to the liner. Check

integrity of joints that have been made and verify that liner has not been damaged by inserting it into sanitary sewer.

2. Service lateral connection test; after all service laterals have been completed for a particular sewer section. Verify integrity of connections at points where they join the liners and existing service lines.

3. Refer to Section 02732 - Acceptance Testing for Sanitary Sewers for applicable test procedures.

B. Inspection: Perform a visual and closed-circuit television inspection of lines.

3.11 SEALING LINER IN MANHOLE

A. Allow liner pipe to normalize to ambient temperatures as well as recover from imposed stretch before cutting to fit between manholes, sealing at manholes, and manhole invert shaping. Normalization usually takes 8 to 10 hours for polyethylene.

B. Cut liner so that it extends 4 inches into manhole. Make a smooth, vertical cut and slope area over top of exposed liner using non-shrink grout.

C. Seal the annular space between liner and sanitary sewer main at each manhole with a chemical seal and nonshrink grout. Place a strip of oakum soaked in sealer in a band to form an effective watertight gasket in the annular space between liner and existing pipes in manhole.

D. Make width of the sealing band a minimum of 12 inches or one-half the diameter of pipe, whichever is greater. Finish seal with a non-shrink grout placed around annular space from inside manhole. Apply grout in a band not less than 6 inches wide. Sealing method, including chemicals and materials, shall be approved by Owner's Representative.

E. Use cementitious grout to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new liner.

3.12 GROUTING ANNULAR SPACE

A. Obtain approval of grouting plan from Owner's Representative before proceeding with the Work.

B. Grout annular space between the outside diameter of liner and inside diameter of existing pipe for all sewer pipes 18 inches and larger, in accordance with Section 02331- Sliplining Grout.

3.13 POST-TELEVISING OF COMPLETED WORK

A. Provide Owner's Representative with a quality color DVD at standard play showing completed Work including condition of restored connections prior to requesting payment. Refer to Section 02732 - Acceptance Testing for Sanitary Sewers.

3.14 FINAL CLEANUP

A. Upon completion of installation work and testing, clean and restore project area affected by the Work.

B. Replace pavement or sidewalks removed or damaged by excavation in accordance with Section 02571 - Pavement Repair and Resurfacing.

C. In unpaved areas, bring surface to grade and slope of surrounding excavation. Replace a minimum of 4 inches of topsoil and seed the area in accordance with Section 02932 - Hydromulch Seeding, or sod the area in accordance with Section 02935 - Sodding, as required.

END OF SECTION

SECTION 02762

SANITARY SEWER SERVICE STUBS OR RECONNECTIONS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of service stubs on new sanitary sewers serving areas where sanitary sewer service did not previously exist.

B. Reconnection of existing service connections along parallel, replacement, or rehabilitated sanitary sewers.

1.02 UNIT PRICES

A. Measurement for sanitary sewer service stubs or service reconnections with stacks located within 5 feet of the sanitary sewer main centerline is on a unit price basis for each stub or reconnection, complete in place. Service stubs and reconnections include service connections, couplings, clean-outs, adapters disconnecting existing services, reconnecting new service, fittings, excavation, backfill, and testing.

B. Measurement for sanitary sewer service stubs or service reconnections without stacks located within 5 feet of the sanitary sewer main is on a unit price basis for each stub or reconnection, complete in place. Service stubs and reconnections include service connections, couplings, clean-outs, adapters, disconnecting existing services, reconnecting new service, fittings, excavation, backfill, and testing.

C. Measurement for sanitary sewer service lines more than 5 feet laterally from the sewer main is on a unit price basis for each stub.

D. Pay estimates for progress payments will be made as measured above according to the following schedule:

1. An estimate for 95 percent payment will be authorized when the reconnection is completely installed and backfilled.

2. An estimate for 100 percent payment will be authorized when the reconnection has been tested as specified in Section 02732 - Acceptance Testing for Sanitary Sewers.

E. One or more connections discharging into a common point are considered one service connection. The Contractor shall not add service reconnections without approval of the Owner Representative. The Owner Representative may require reconnections to be moved or relocated to avoid having more than two houses per reconnection.

F. Measurement for abandonment of service connection is on a unit price basis for each abandoned connection. No separate payment will be made for abandonment of service connection unless excavation is required. No separate payment will be made for excavation of sanitary sewer services within the new or replacement sewer trench.

G. No separate payment will be made for an abandoned service connection if the service to be abandoned is within 4 feet of an active connection. Payment for only one abandoned service connection will be allowed when a second abandoned connection is within 4 feet of the first.

1.03 PERFORMANCE REQUIREMENTS

A. Accurately locate in the field all proposed service stubs along the new sanitary sewer main.

B. Properly disconnect all existing connections from the existing sewer and reconnect to the rehabilitated liner, as described in this Section.

C. Accurately locate in the field existing service connections and proposed service stubs along the alignment of the new parallel or replacement sewer main.

D. Reconnect all service connections, including those that go to unoccupied or abandoned buildings or to vacant lots, unless directed otherwise by the Owner Representative.

E. Begin reconnection of service lines immediately after cured-in-place liner has cured.

F. Reconnection by the excavation method shall include the stack and 4-feet of service line, as necessary to the property line for which the connection is intended. The service lines shall be replaced to the right-of-way or easement line (short side and long side) and a cleanout installed at that location.

G. When establishing service to a previously un-served property, contractor is responsible to determine proper placement of service to maximize efficiency of system and minimize insurance of existing system.

1.04 SUBMITTALS

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

B. Submit product data for each pipe product, fitting, coupling and adapter.

C. Show reconnected services on record drawings. Give the exact distance from each service connection to the nearest downstream manhole.

PART 2 P R O D U C T S

2.01 PVC SERVICE CONNECTION

A. As stubouts, use PVC sewer pipe, 4-inch through 10-inch, conforming to ASTM D 1784 or D1785 Schedule 40, with a cell classification of 12454-B.

B. PVC pipe shall be gasket jointed with gasket conforming to ASTM D3319.

C. Provide service connection pipe in sizes shown on the Drawings. For reconnection of existing services, select service connection pipe diameter to match existing service diameter.

D. Provide a 6-inch service connection when more than one service discharges into a single pipe.

E. Connect service pipes to new parallel or replacement sewer mains with prefabricated, full-bodied tee or wye fittings conforming to specifications for the sewer main pipe material as specified in other Sections for all sewers up to 18 inches in diameter.

F. Where new sewers are installed using pipe augering or tunneling, or where the new sewer is greater than 18 inches in diameter, use Fowler "Inserta-Tee" to connect the service to the new sewer main.

2.02 PIPE SADDLES

A. Use pipe saddles only on rehabilitated sanitary sewer mains. Comply with Paragraph 2.01E for new parallel and replacement sanitary sewer mains.

B. Supply one-piece prefabricated saddle, either polyethylene or PVC, with neoprene gasket to accomplish a complete seal. Use a saddle fabricated to fit the outside diameter of the pipe to which it will be attached. The protruding lip of the saddle must be at least 5/8-inch long with grooves or ridges to retain the stainless steel band clamps.

C. Use 1/2-inch stainless steel band clamps for securing saddles to liner pipe. The screws, bolts, and associated appurtenances shall be stainless steel.

D. Inserta Tee fittings (includes PVC Hub, Rubber Sleeve, and Stainless Steel Band) as manufactured by Inserta Tee Fittings, Co. shall be used for stacks, service reconnections (by excavation) and for drop connections.

2.03 COUPLINGS AND ADAPTERS

A. For connection between new PVC pipe stubout and existing service; 4-, 6-, or 8-inch diameter, use flexible adapter coupling consisting of a neoprene gasket and stainless steel shear ring, with 1/2-inch stainless steel band clamps:

1. Fernco Pipe Connectors, Inc., Series 1055 with shear ring SR-8;

2. Band Seal by Mission Rubber Co., Inc.;

3. Approved equal.

B. For connection between new PVC pipe stub out and new service, use rubber-gasketed adapter coupling:

1. GPK Products, Inc., IPS & Sewer Adapter.

2. Approved Equal.

2.04 STACKS

A. Provide stacks for service connections wherever the crown of the sewer is 8 feet or more below finished grade.

B. Construct stacks of the same material as the sanitary sewer and as shown on the Drawings.

C. Provide stacks of the same nominal diameter at the sanitary service line.

2.05 CLEAN-OUTS

A. Install clean-outs at property line on each service connection as shown in detail on the Drawings.

2.06 PLUGS AND CAPS

A. Seal the upstream end of unconnected sewer service stubs with rubber gasketed plugs or caps of the same pipe type and size. Provide plugs or caps by GPK Products, Inc., or equal.

PART 3 E X E C U T I O N

3.01 PERFORMANCE REQUIREMENTS

A. Provide a minimum of 72 hours notice to customers whose sanitary sewer service will potentially be interrupted.

B. Accurately field locate service connections, whether in service or not, as pipe laying progresses from downstream to upstream.

C. Properly disconnect existing connections from the sewer and reconnect to the new sewer, as described in this Section.

D. Reconnect service connections, including those that go to unoccupied or abandoned buildings, unless directed otherwise by the Owner Representative. Plug the service connection at the R.O.W. for vacant lots.

E. Complete reconnection of service lines within 24 hours after disconnection.

F. Reconnection shall include the stack and fittings and required pipe length to reconnect service line.

G. Connect services 8 inches in diameter and larger to the sewer by construction of a manhole. Payment for the manhole will be made at the contract unit price for the appropriate manhole diameter and depth.

3.02 PROTECTION

A. Provide barricades and warning lights and signs for excavations created for service connections. Conform to requirements of Section 01570 - Traffic Control and Regulation.

B. Do not allow sand, debris or runoff to enter sewer system.

3.03 PREPARATION

A. Where sewers are existing, field locate existing service connections, whether in service or not. Use existing service locations to reconnect service lines to new liner or new sanitary sewer main.

B. For new parallel and replacement sanitary sewer mains, complete testing and acceptance of downstream sewers as applicable. Provide for compliance with requirements of Paragraph 3.01E.

3.04 EXCAVATION AND BACKFILL

A. Excavate in accordance with Section 02227 - Excavation and Backfill for Utilities.

B. Provide barricades and warning lights and signs, for excavations created for service connections. Conform to requirements of the Texas Manual on Uniform Traffic Control Devices.

C. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 - Trench Safety System for excavations requiring trench safety.

D. Install and operate necessary ground water and surface water control measures in accordance with requirements of Section 01563 - Control of Ground Water and Surface Water.

E. Do not allow sand, debris or runoff to enter sewer system.

3.05 SERVICE RECONNECTION BY EXCAVATION METHOD TO SANITARY SEWER PIPE REHABILITATED BY PIPE BURSTING, CURED IN PLACE LINER, AND SLIPLINING

A. Remove a portion of existing sanitary sewer main to expose the liner pipe. Provide sufficient working space for installing a prefabricated pipe saddle.

B. Carefully cut the liner pipe making a hole to accept the stubout protruding from the underside of the saddle. In the event the Contractor chooses to cut the liner pipe using a remote device prior to excavation, no additional payment shall be made for such efforts.

C. Strap on the saddle using a stainless steel band on each side of the saddle. Tighten the bands to produce a watertight seal of the saddle gasket to the liner pipe. Stainless steel bands shall be strapped 360° around line and pipe with the existing pipe removed.

D. Use a saddle with a stubout that protrudes into the liner a depth equal to the liner pipe wall thickness.

E. Remove and replace service line to the street right of way line.

F. Make up the connection between liner and existing service line using PVC sewer pipe and approved couplings and stainless steel bands to construct new stub outs and/or stacks.

G. Encase the entire service connection in cement stabilized sand. Place a minimum of 6-inches below and 12-inches above and on the sides of the pipe connections.

H. Test the service connections before backfilling.

3.06 SERVICE RECONNECTION ON POINT REPAIR, REMOVE AND REPLACE PIPE OR NEW PIPE

A. Install the new service connection on the new sanitary sewer main for each service connection.

B. Remove and replace cracked, offset or leaking service line for up to 5 feet, measured horizontally, from the centerline of the new sanitary sewer main.

C. Make up the connection between the new main and the existing service line using PVC sewer pipe and approved couplings, as shown on the Drawings.

D. Test service connections before backfilling.

E. Embed the service connection and service line as specified for the new sanitary sewer main at this location, and as shown on the Drawings. Place and compact trench zone backfill in compliance with Section 02227 - Excavation and Backfill for Utilities.

3.07 RECONNECTION ON CURED-IN-PLACE SEGMENTS (REMOTE METHOD) PRIOR TO RECONNECTION BY EXCAVATION

A. Service reconnections shall be made using remote operated cutting tools prior to reconnection by excavation on cured-in-place liners.

B. The method and equipment used shall restore the service connection capacity to not less than 90 percent of original capacity.

C. The Contractor shall immediately open any missed connections and repair any holes drilled in error, by a method approved by the Owner Representative.

D. Complete reconnection by excavation as per Item 3.05.

3.08 PROTRUDING TAPS

A. Pipebursting and Sliplining

1. Protruding taps or service connections which obstruct the passage of the television inspection camera during cleaning and during television inspection operations or the insertion of the liner while pulling or pushing shall be removed to allow the liner to pass through. Reconnection of this service to new carrier pipe shall be paid for as a service reconnection.

2. No payment shall be made at this location for any obstruction removal.

3. Abandoned taps/ services which are protruding and which must be removed to allow the liner to be inserted into the sewer and the service abandoned, shall not be paid for as an obstruction removal. Payment shall be made for abandonment of service connection.

B. Cured-in-Place Method of Rehabilitation

1. See Obstruction Removal (by Remote) Section 02769 and Point Repairs to Sanitary Sewers - Section 02763.

3.09 INSTALLATION OF NEW SERVICE STUBS

A. Install the new service connections on the new sanitary sewer main for each service connection. Provide the length of stub indicated on the Drawings. Install plug or cap on the upstream end of the service stub as needed.

B. Test service connections before backfilling.

C. Embed the service connection and service line as specified for the new sanitary sewer main at this location, and as shown on the Drawings. Place and compact trench zone backfill in compliance with Section 02227 - Excavation and Backfill for Utilities.

3.10 TESTING

A. Test service reconnections and service stubs. Follow applicable procedures given in Section 02732 - Acceptance Testing for Sanitary Sewers.

3.11 CLEANUP

A. Backfill the excavation as specified in Section 02227 - Excavation and Backfill for Utilities.

B. Replace pavement or sidewalks removed or damaged by excavation in accordance with Section 02571 - Pavement Repair and Resurfacing. In unpaved areas, bring surface to grade and slope surrounding the excavation. Replace a minimum of 4 inches of topsoil and seed according to requirements of Section 02932 - Hydromulch Seeding.

C. Conform to Section 01564 - Waste Material Disposal.

END OF SECTION

SECTION 02763

POINT REPAIRS TO SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Repairs to existing sewer lines by replacing short lengths of failed pipe.

1.02 UNIT PRICES

A. Measurement for point repairs is on a unit price basis for each repair performed on each material type and diameter within depth ranges listed in the following table. Depth shall be measured from natural ground level to flow line of sanitary sewer main at point of repair. All excavation, diversion pumping, material, surface restoration and televising is incidental.

B. Measurement for extra length repair is on a linear foot basis for each material type and diameter in excess of replacement lengths given in Paragraph 1.05.

C. Measurement for hand excavation is on a cubic yard basis when authorized by the Owner's Representative in locations where excavation by machine is not suitable.

D. If point repair is abandoned, payment will be made on a cubic yard basis for excavation required to expose existing pipe. Separate measurement will be made for machine excavation and hand excavation.

E. Diversion pumping, if required, is incidental to the cost of the point repair.

1.03 PERFORMANCE REQUIREMENTS

A. Locate and replace small lengths of one or more pipe sections where isolated line failure has occurred due to settlement, corrosion, crushing or separation of joints.

B. Owner's Representative may identify potential locations for point repair, but Contractor is responsible for verifying locations.

C. Owner's Representative will authorize each point repair after failed points are located. Do not make point repairs without prior approval of Owner Representative.

D. Replace carrier pipe for all point repairs unless otherwise directed by Owner Representative.

E. Minimum length of pipe to be replaced shall be determined by the Owner's Representative.

1.04 SUBMITTALS

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

B. Submit product data for each pipe product, fittings, and jointing material.

C. Submit certified test results prepared by manufacturer for jointing material integrity.

D. Submit alternative lining systems for ductile iron pipe for approval.

1.05 SEQUENCING

A. Complete point repairs before rehabilitating sewer between adjacent manholes.

B. Clean line and make closed-circuit television inspection for each point repair.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Materials for point repairs, other than those specified, may be considered for use in rehabilitation of existing sewers.

B. For consideration of other materials, submit complete manufacturer's data including material, sizes, flow carrying capacity, installation procedures and history of similar installations to Owner Representative for evaluation

2.02 PVC PIPE

A. PVC sewer pipe and joints: 6 inch through 18-inch pipe conforming requirements of Section 02620.

2.03 DUCTILE IRON PIPE

A. Ductile iron pipe: 4 inch thorough 48 inch, conforming to requirements of Section 02610.

B. Fittings: Push-on end joint fittings with bell-and-spigot ends, with bell modified for push-on joint, conforming to requirements of Section 02610.

C. Interior Coating: Conform to requirements of Section 02610 for sanitary sewers.

D. Exterior coating: 8-mil polyethylene tubular material conforming to requirements of Section 02630.

2.04 REINFORCED CONCRETE PIPE

A. Reinforced concrete pipe and joints: Conform to requirements of Section 02615. Reinforced concrete pipe may be used for sewers 24-inches in diameter and larger.

2.05 JOINTING MATERIALS

A. Use Fernco adapters secured with 1/2-inch stainless steel bands, or approved equal.

PART 3 E X E C U T I O N

3.01 PROTECTION

A. Provide barricades and warning lights and signs, for excavations created by point repairs.

B. Do not allow sand, debris or runoff to enter sewer system.

3.02 EXCAVATION

A. Excavate trenches in accordance with Section 02227.

B. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 for excavations over 5 feet deep.

C. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01563.

3.03 DIVERSION PUMPING

A. Install and operate diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Owner Representative.

B. Design all piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify Owner Representative so that required reporting can be made to the TCEQ and the Environmental Protection Agency.

3.04 TYPICAL SEQUENCE OF POINT REPAIR

A. Survey, clean and televise to verify the location of point repair.

B. Excavate to the minimum length of existing pipe to be replaced.

C. Prior to replacing pipe, determine condition of the existing line on both sides of point repair by lamping the line a minimum of 10 feet in each direction. Determine whether additional lengths of line beyond "minimum length" criteria, need replacement. Report need for additional replacement to Owner Representative and obtain approval before proceeding.

D. Remove and replace failed pipe and connect to existing pipe using Fernco couplings. If joints cannot be made watertight using Fernco adapters, place waterstop gaskets on each joint and encase in a reinforced concrete collar as indicated on the Drawings. Place concrete as specified in Section 03305. Reconnect affected service connections or stacks.

E. Establish proper grade for the pipe being replaced using methods acceptable to Owner Representative.

F. After completion of point repair, but prior to backfill, perform a smoke test in the presence of Owner Representative. Testing as specified in Section 02732. Repair and retest sections that fail.

G. Encase exposed pipe in cement stabilized sand conforming to Section 02252 as indicated on Drawings.

H. Backfill the excavation as specified in Section 02227.

I. Replace pavement or sidewalks removed or damaged by excavation in accordance with Section 02571. In unpaved areas, bring surface to grade and slope surrounding the excavation. Replace a minimum of 4 inches of topsoil and seed area in accordance with Section 02932.

J. Perform a post-completion TV inspection as specified in Section 02732. Point repairs that have offset joints, non-uniform grade or alignment, or other unsatisfactory conditions, shall be rejected. Replace pipe and bedding as required when work is rejected.

3.05 ABANDONMENT OF POINT REPAIR

A. If a pipe is exposed and found in good condition, not requiring a point repair, notify Owner Representative who will record abandonment of point repair.

B. Backfill the excavation, replace pavement or sidewalk and repair and seed or sod unpaved areas, as specified in paragraph 3.04.

END OF SECTION

SECTION 02764

MANHOLE REHABILITATION

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Repair, rehabilitation, or replacement of deteriorated, leaking, or structurally unsound manholes.

B. All physically deteriorated, leaking or structurally unsound sanitary sewer manholes, and cleanouts shall be rehabilitated per the provisions of this item. Such manholes shall be rehabilitated by one (1) of the following methods:

1. New manholes constructed of cast-in-place concrete or precast concrete as shown on the plans and stated in the specifications.
2. Rehabilitation by use of a liner. (A liner is defined as an applied or inserted product that improves the structural integrity of the manhole).
3. Rehabilitation by use of a corrosion resistant material. A cementitious liner can be may be applied to the manhole prior to the installation of the corrosion resistant material if stated in the plans.
4. Other rehabilitation work.

1.2 PERFORMANCE REQUIREMENTS

A. Perform work needed to make manholes structurally sound, improve flow, prevent entrance of inflow or groundwater, prevent entrance of soil or debris, and provide protection against hydrogen sulfide gas attack.

B. Manufacturer's Product Support.

1. Through the Contractor, manufacturers of wall sealing or lining systems shall submit to Owner’s Representative for review and approval a detailed description of the proposed rehabilitation process. Describe surface preparation, independent laboratory test results, mix design procedures and method of controlling uniform thickness.
2. A representative employed by the manufacturer and having technical training in admixture and concrete mix design shall be named and available for consultation by telephone during business hours and on site upon 48 hours notices.
3. Manufacturer's representative on concrete lining systems shall provide technical assistance to concrete batch plant operators to ensure proper usage of dispensing equipment and accurate proportions of admixtures.

1.3 SUBMITTALS

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

B. Product Data: Submit product data, including surface preparation instructions and application instructions, from manufacturer of wall repair materials, hydraulic cements, quickset mortars, specialized sealants, and grouts.

C. Installer Qualifications. Installers of liners and wall repair systems shall submit qualifications to Owner's Representative at least 14 days prior to start of any material application. Submittal shall consist of:

1. Manufacturer's approved equipment list, by name and model number for application of product and contractor's equipment list showing approved equipment available for use in product application.
2. List of contractor's personnel who have satisfactorily completed manufacturer's training in product application within previous two years. Include date of certification for each person.

D. Progress Photographs:

1. After cleaning and sealing each manhole, submit 3" x 5" color photographs of manhole's interior walls for review by Owner's Representative. Owner's Representative may inspect the manhole before giving approval to begin lining.
2. After liner installation of each manhole, submit a minimum of three additional 3" x 5" color photographs to show final condition of rehabilitated manhole.
3. Provide photographs of sufficient quality and clarity so that interior condition can be readily determined by Owner's Representative.
4. Annotate each photograph. Give date, manhole number, material used, and appropriate remarks on the back using permanent ink.

1.4 PROJECT CONDITIONS

A. Manholes Containing Mechanical or Electrical Equipment:

1. Drawings may not show locations of flow monitoring equipment. If a manhole contains any mechanical hardware or electrical flow monitoring equipment immediately notify Owner's Representative.
2. Reschedule work in such manholes until equipment has been removed by Owner and further instructions are given.
3. Do not subject manholes with mechanical hardware or electrical equipment to diversion/bypass pumping.
4. Damage to installed equipment, due to negligence of Contractor, will be repaired by Owner and cost of repairs charged to Contractor.

B. Field Location of Manholes, Cleanouts and Inlets:

1. Contractor is responsible for locating and uncovering all manholes and cleanouts in lines being rehabilitated. If difficulty is encountered in locating a manhole or

cleanout covered by ground or pavement, notify Owner's Representative and await instructions.

2. Manholes may be located within project limits which are not part of the system being rehabilitated. Properly identify manholes before starting cleaning and sealing operations.

1.5 SALVAGE

A. Manhole covers and frames, inlet grates and frames, and adjusting rings from abandoned manholes and inlets remain the property of the Owner. Deliver salvaged items to locations designated by Owner's Representative.

PART 2 P R O D U C T S

2.1 WALL CLEANING MATERIAL

A. High Pressure Water: 3500-psi minimum force.

B. Cleaners: Detergent or muriatic acid capable of removing dirt, grease, oil and other matter which would prevent a good bond of sealing material to wall. Refer to sealing material manufacturer's recommendations.

2.2 WALL REPAIR MATERIALS

A. Hydraulic Cements: Use a blend of cement powders or hydraulic cement to stop active leaks in the manhole structure.

B. Quickset Mortar: Use a quickset mortar to repair wide cracks, holes or disintegrated mortar.

2.3 MANHOLE CEMENTITIOUS LINER

A. This method consists of spray applying a cementitious mix to the manhole walls and benches on the existing manholes resulting in a monolithic liner having a minimum thickness of 1-inch of dry mil (1000 mils). The mix(es) shall be batches in accordance with manufacturer's recommendations. Adding water to facilitate application at the nozzle will not be allowed.

B. Provide preapproved cementitious structural rehabilitation liner material for use as a liner for manhole and to repair and reform manhole benches and inverts. Use a pre- approved cementitious structural manhole rehabilitation material which developed a minimum compressive strength of 3000 psi at 14 days as, tested per the provisions of ASTM C1140. Follow manufacturer's recommended batching and mixing instructions.

C. Select manhole wall liner material from the following list of preapproved products and shall have a minimum finished dry thickness of 1000 mils:

1. Permacast CR-9000 (AP/M Permaform)
2. Manhole Mortar
3. QM-1S (Quadex)
4. Strong Seal-MS-2C
5. Reliner MSP
6. Permacast-MS-10,000 (AP/M Permaform)
7. Emaco S88C
8. Or approved equal

2.4 CORROSION RESISTANT MANHOLE MATERIALS

A. The materials to be utilized in the lining of manholes shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. Manufacturer of corrosion protection products shall have long proven experience in the production of the lining products utilized and shall have satisfactory installation record.

B. The materials shall be applied by an approved certified applicator and must meet the manufacturer's recommendations. Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.

C. Acceptable products include the following (alternates must be approved by the City):

1. Sprayroq protective liner system (SprayWall**)** (SprayWall – 125 dry mils**)**

2. Carboline Plasite 4500 (125 dry mills)

3. Spectra Shield (manufacture recommendations)
4. or approved equal.

D. The Contractor shall make provisions in their unit price bid for each structure to maintain dry conditions for the corrosion resistant liner application and subsequent curing as per manufacturer's recommendations.

2.5 BENCH FORMING/REPAIR MATERIALS

A. Use corrosion resistant concrete containing microsilica admixtures to repair and reform manhole benches and inverts, as specified in Section 03305.

2.6 MANHOLE COVER, FRAME AND INSERTS

A. See Details on Plan Drawings.

B. Provide manhole inserts including new dish, gasket and relief valves. Select appropriate watertight inserts to fit walls and frames of manholes.

1. Supply inserts as manufactured by Southwestern Packing and Seals, or an approved equal.
2. Inserts shall be stamped with the words, "Property of City of Galveston".
3. Provide a frame-to-manhole seal as manufactured by Cretex, or approved equal.

PART 3 E X E C U T I O N

3.1 PROTECTION

A. Provide barricades and warning lights and signs for excavations created by manhole or cleanout removal.

B. Do not allow sand, debris or runoff to enter sewer system.

3.2 EXCAVATION

A. Excavate in accordance with Section 02227.

B. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 for excavations over 5 feet deep.

C. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01563.

3.3 BYPASS PUMPING

A. Install and operate diversion pumping equipment to maintain sewage flow and to prevent backup or overflow in accordance with requirements of the appropriate Section. Obtain approval for diversion pumping equipment and procedures from Owner’s Representative.

B. Design all piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify Owner’s Representative so that required reporting can be made to the TCEQ and Environmental Protection Agency.

3.4 ABANDONMENT OF CLEANOUTS AND MANHOLES

A. Abandon cleanouts or manholes designated on Drawing or as directed by the Owner’s Representative.

B. If a manhole is to be abandoned on a rehabilitated line, install a carrier pipe through the structure and fill manhole with cement stabilized sand, compacted to a level 2 feet above top of carrier pipe.

C. Fill remainder of manhole with selected backfill material to 2 feet below ground level.

D. Dismantle manhole including frame, to 2 feet below ground level. Fill void to existing ground level with select backfill material compacted to 95% Proctor Density.

E. If manhole to be abandoned is in a paved street, backfill manhole as described above with cement stabilized sand in lieu of select backfill material.

3.5 MANHOLE WALL CLEANING

A. The floor and interior walls of the manhole shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, oils, grease, sludge, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate.

1. High pressure water blasting with a minimum of 3500 psi shall be used to clean free all foreign material within the manhole.
2. When grease and oil are present within the manhole, an approved detergent or muriatic acid shall be used integrally with the high pressure cleaning water.
3. All materials resulting from the cleaning of the manhole shall be removed prior to application of the cement based coating.
4. All loose or defective brick, grout, ledges, steps and protruding ledges shall be removed to provide an even surface prior to application of coating.

B. Prevent any foreign material from entering the adjoining pipes. Remove droppings of foreign and wall sealant materials before they harden on the bottom of the manhole.

C. No separate pay shall be made for this item. Include cost for sealing in the unit price for manhole liner.

D. Manufacturer's representative shall be available at all times on site to answer questions and approve manhole preparation work prior to lining.

3.6 MANHOLE WALL SEALING

A. Seal active leaks in the manhole structure by using a blend of cement powder or hydraulic cement.

B. Remove loose or defective wall material. Wipe or brush surface clean prior to the application of hydraulic cements.

C. Drill weep holes at bottom of manhole walls to relieve hydrostatic pressure to stop leaks. Plug pressure relief holes after leaks are stopped using hydraulic cement materials. Lead wool may also be used to plug large leaks.

D. Repair wide cracks, holes, or disintegrated mortar with quickset mortars. Follow manufacturer's application procedures.

E. Reshape manhole inverts before wall sealing work. Apply concrete to cleaned manhole benches as specified in Section 03305.

F. After all active leaks have been stopped, clean and prepare walls for application of selected liner material.

G. Properly apply the sealing compound to provide the minimum required uniform coating to the wall surface.

H. Prevent any foreign material from entering the adjoining pipes. Remove droppings of foreign and wall sealant materials before they harden on the bottom of the manhole.

I. Strictly follow product manufacturer's published technical specifications and recommendations for surface preparation, application and proportioning.

3.7 CEMENTITIOUS LINER

A. Apply cementitious liner to a thickness of 1-inch using a steel trowel to provide a smooth, even surface. Finish and cure concrete as specified in Section 03305.

B. Cementitious liner material may be applied using spray application methods. Use steel trowel to provide a smooth, even surface before final set.

3.8 FIBERGLASS LINER

A. A manhole may be rehabilitated using a fiberglass liner if existing manhole has a minimum 45-inch inside diameter and a depth of at least 4-feet.

B. Clean manhole and remove corbel section until a 45-inch diameter opening is formed. Owner’s Representative may direct Contractor as to amount of corbel or wall to be removed. Do not allow debris to fall into sewer lines.

C. When calculating depth of a fiberglass manhole, allow for a minimum of 18-inches of adjustment rings to be placed between casting bottom and the manhole top. Set adjustment rings in approved grout or mortar.

D. Cut the bottom of rehabilitation manhole to fit evenly on benches or chip benches out to evenly support base.

E. Determine exact location of incoming and outgoing service lines in existing manhole and cut accurate openings for a close fit into manhole.

F. Place the fiberglass liner manhole concentrically into the existing manhole with the openings aligned with existing sewers. Use spacer guides in annular space between existing and rehabilitation manhole. Seal openings with Oakum soaked in sealing gel.

G. Use quick-set hydraulic cement around inside base of the fiberglass manhole and inside the annular space for a depth of 6-inches.

H. Fill the remaining annular space with grout after the hydraulic cement at the bottom has dried. Consolidate grout using a method approved by the Owner's Representative.

I. After the grout has set, install adjustment rings, FRP liner, frame and cover.

J. Line rings using a one-piece fiberglass reinforced pipe (FRP). Seal pipe to casting and manhole with sealing compound. Grout annular space between the FRP and adjustment ring.

3.9 MANHOLE BENCHES/INVERTS

A. Remove obstructions and loose materials from benches prior to shaping the invert. Form a smooth, U-shaped invert having a minimum depth of one-half pipe diameter and channel it across the floor of the manhole using a quickset mortar. Control flow to allow sufficient setting time for material used.

B. Make finished benches smooth and without defects which would allow for accumulation of debris.

3.10 MANHOLE COVERS AND FRAMES

A. Adjust manhole frames and covers found above or below grade and reset loose frames. Make adjustments with concrete rings or approved materials. Set frames in a full bed of non-shrink grout and adjust to surrounding grade as specified in the pertinent section. Protect bottoms of manhole from debris or soil during adjustment. Contractor shall accurately measure dimensions of the manhole required for the application prior to submitting the shop drawing for review by Engineer. Using more than one concrete ring to adjust the manhole elevation to be flush with the road is unacceptable and suggests lack of planning by Contractor.

B. Install watertight manhole covers and frames at locations shown on the Drawings or as instructed by Owner's Representative. Use new frames and covers.

C. For new sanitary sewer manholes subject to loading or differential movement at manhole frames, and for all rehabilitated manholes, install manhole chimney seals to prevent inflow between manhole frames and masonry chimneys. Refer to Section 02603.

3.11 FIELD QUALITY CONTROL

A. Inform Owner's Representative immediately if materials being used are not producing required results or need modification. Owner's Representative has the right to stop use of any material at any time.

3.12 INSPECTION

A. After manhole wall sealing or manhole rehabilitation has been completed, visually inspect the manhole in the presence of Owner's Representative. Check for cleanliness and for elimination of active leaks.

B. At completion of manhole rehabilitation assist Owner's Representative in verifying installation of minimum coating thickness of concrete liner. Test several points on the manhole wall. Repair verification points prior to final acceptance for payment.

C. During application of corrosion resistant liner, a wet film thickness gauge, meeting ASTM D4414, shall be used. Measurements shall be taken, documented and attested by the Contractor for submission to the Owner.

D. At completion of manhole rehabilitation, assist Owner's Representative in inspection of installation, sealing and grouting of fiberglass liner.

3.13 TESTING

Manholes shall be tested separately and independently of the wastewater lines (after they are plugged inside the manhole).

B. Test by the Vacuum Method

Vacuum Test shall be performed per ASTM C1244-05 "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill". Manholes will be tested after installation with all connections in place. The structural soundness of the manhole for the vacuum testing shall be certified and sealed in writing by the Engineer of Record and manufacturer to the City Engineer in advance of the testing. Successful Vacuum Testing (approved by Engineer of Record or the City) after backfill and compaction are complete will be the basis for acceptance of the manhole.

Equipment:

a) The manhole vacuum tester shall be a device approved for use by the Engineer or designated representative.

b) Pipe sealing plugs shall have a load resisting capacity equal to or greater than that required for the size of the connected pipe to be sealed.

Procedures:

a) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before installation or unless it is applied at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.

b) After cleaning the interior surfaces of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer. Plugs and the ends of pipes connected by flexible boots-shall be blocked to prevent their movement during the vacuum test.

c). The vacuum test head shall be placed on the top of the cone section or, inside of the top of the manhole cone section, and the compression seal band inflated to the pressure recommended by its manufacturer. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches of mercury [(-5 psig) has been attained, the valve shall be closed and the time noted. Tampering with the test equipment will not be allowed.

d) The manhole shall have passed the test if the vacuum does not drop below 9 inches of mercury [(-4.5 psig) within three (3) minutes of the time the valve was closed. The actual vacuum shall be recorded at the end of the three (3) minutes during which the valve was closed.

e) When the standard vacuum test cannot be performed because of design or material constraints (examples: T-Type manholes, T-Lock Liners, or other reasons acceptable to the Engineer or designated representative), testing of individual joints shall be performed as directed by the Engineer or designated representative.

B. Test by the Exfiltration Method

At the discretion of the Engineer or designated representative, the Contractor may substitute the Exfiltration Method of testing for the Vacuum test described in Section A above. This method may only be used when ground water is not present. If ground water is present a Vacuum Test shall be used unless otherwise directed by the Engineer or designated representative. All backfilling and compaction shall be completed prior to the commencement of testing.

The procedures for the test shall include the following:

a) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before

field assembly, or at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.

b) After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer.

c) Concrete manholes shall be filled with water or otherwise thoroughly wetted for a period of 24 hours prior to testing.

d) At the start of the test, the manhole shall be filled to the top with water. The test time shall be 1 hour (60 minutes). The Construction Inspector must be present for observation during the entire time of the test. Permissible loss of water in the 1 hour test time is 0.025 gallons per diameter foot, per foot of manhole depth. For example, for a 4 foot diameter manhole, this quantity converts to a maximum permissible drop in the water level (from the top of the manhole cone) of 0.05 inches per foot of manhole depth or 0.5 inches for a 10 foot deep manhole.

C. Holiday Testing

After the coating product(s) have set in accordance with manufacturer instructions, all surfaces shall be inspected for holidays with high-voltage holiday detection equipment. Reference NACE RPO 188-99 for performing holiday detection. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating can be hand applied to the repair area. All touch-up/repair procedures shall follow the coating manufacturer's recommendations. Documentation on areas tested, results and repairs made shall be provided to Owner by Contractor.

D. Inspection

The Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is considered to be in its final condition. The inspection shall determine the completeness of the manhole; any defects shall be corrected to the satisfaction of Engineer or designated representative.

Visual inspection will include but no be limited to the following:

1. Observation for identification for leakage into the manhole as well as general workmanship.
2. Verification that there are no infiltration, cracks, or loose material.
3. Observation of the Installed liner system to make sure it is completely free of pinholes and hollow spots/voids and other defects that will reduce the life expectancy of the applied system.
4. Observation of the Liner to ensure it is free of severe wrinkles, areas deficient of resin, delamination of the fabric layers, infiltration, large hollow areas behind the liner and any other defects that will affect the life expectancy.

5. Observation of the Liner to ensure it is free of severe wrinkles, areas deficient of resin, delamination of the fabric layers, infiltration, large hollow areas behind the liner and any other defects that will affect the life expectancy of the Composite Liner.
6. Observation to verify that there are no loose panels, peeling, bubbles, or other areas that may hinder the performance of the liner.
7. Observation to insure bonding, resin saturation, complete cure and a smooth surface free from cracks or hollow spots.

E. Failure to Pass the Test - Records of Tests.

If the manhole fails to pass the initial test method as described in (A) Test by the Vacuum Method and, if allowed, (B) Test by the Exfiltration Method, or if visible groundwater leakage into the manhole is observed, the Contractor shall locate the leak, if necessary by disassembly of the manhole. The Contractor shall check the gaskets and replace them if necessary. The Contractor may re-lubricate the joints and re-assemble the manhole, or the Contractor may install an acceptable exterior joint sealing product on all joints and then retest the manhole. If any manhole fails the vacuum and/or exfiltration test twice, or unable to pass the Holiday test, the Contractor shall consider replacing that manhole. If the Contractor chooses to attempt to repair that manhole, the manhole must be retested until it passes. In no case shall cold applied preformed plastic gaskets be used for repair. Records of all manhole testing shall be made available to the Engineer or designated representative at the close of each working day, or as otherwise directed by the Engineer or designated representative. Any damaged or visually defective products, or any products out of acceptable tolerance shall be removed from the site.

3.14 BACKFILL

A. Backfill and compact soil in area of excavation surrounding manholes in accordance with Section 02227.

B. In unpaved areas, grade surface at a uniform slop of 1 to 5 from the manhole frame to natural grade. Provide a minimum of 4 inches of topsoil conforming to requirements of Section 02920 and either seed according to Section 02932 or sod according to Section 02935, as required.

END OF SECTION

SECTION 02768

PIPE BURSTING/CRUSHING SANITARY SEWERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Pipe Bursting/Crushing existing sanitary sewers.

1.02 UNIT PRICES

A. The unit price bid for rehabilitating the sewer main shall be full compensation for all materials, labor, equipment and incidentals required to install the replacement pipe within the sewer main. Payment for the replacement pipe shall also include the cost of sealing the replacement pipe in the manholes, reworking the manhole inverts and benches, etc. Payment shall be for actual linear footage for replacement pipe installed in the field and shall be measured between the centerlines of the manholes. Cleaning and television inspection (pre and post rehabilitation) and relevant submittals shall be incidental to the project.

B. All costs for testing the replacement pipe and the service reconnections shall be considered incidental to the cost of rehabilitating the sewer. The Contractor shall be responsible for making adequate and suitable arrangements for any bypass pumping that may become necessary to prevent any backflow into houses or buildings, or onto the streets between the time the replacement pipe is installed and the service reconnections have been made, tested, and approved by the City. Bypass pumping shall be performed in accordance with Section 02790 - Bypass Pumping and shall be incidental.

C. Payment for service connections restored by excavation and reconnecting with approved fittings shall be made in accordance with Section 02762 - Service Reconnections. Excavation for service connection which is found plugged and no longer required shall be left as is, and paid as per appropriate bid item for Abandonment of Service Connection. The payment for pipe bursting shall be based on the depth of the deeper flow line of the rehabilitated segment. Two or more service laterals from several houses coming at one point to the sewer (replacement pipe) through stacks, wyes and/or tests, shall be considered as one service connection. However, the Owner’s Representative may move/relocate such service connections so as not to exceed more than two houses per each new connection pipe.

D. The Contractor will submit all post color DVD’s in electronic format to the City for acceptance prior to payment.

E. All other payment shall be made as per bid items. No payment shall be made for work considered incidental or complimentary to a pay item already in bid item. The Contractor shall clarify, for his own benefit, all work required for any item, incidental or otherwise, prior to bidding.

1.03 DEFINITIONS

A. Pipe Bursting/crushing: The pipe bursting/crushing process is defined as the reconstruction of existing sanitary sewers by the simultaneous insertion of a liner pipe within the bore of the existing pipe, by breaking and expanding the old pipe.

1.04 SYSTEM DESCRIPTION

A. The pipe bursting/crushing process involves rehabilitation of deteriorated gravity sewer pipe by installing new pipe material within the enlarged bore created by using a static, hydraulic, or pneumatic hammer molding device, suitably sized to break the old pipe or by using a modified boring knife with a flared plug that crushes the existing sewer pipe. Forward progress of the mole or the knife may be aided by hydraulic equipment or other apparatus. Replacement pipe is either pulled or pushed into the bore.

1.05 QUALITY ASSURANCE

A. Liner Acceptance: Provide liner material which is homogeneous without defects and manufactured to the standards and dimensions specified. Cause for rejection includes physical defects of the liner, such as concentrated ridges, discoloration, excessive spot roughness, pitting, visible cracks, foreign inclusions, and varying wall thickness.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prevent injury or abrasion to pipe during loading, transportation, and unloading. Do not drop pipe from cars or trucks, nor allow pipe to roll down skids without proper restraining ropes. Use suitable pads, strips, skids, or blocks for each pipe during transportation and while awaiting installation in the field.

B. Pipe with cuts, gashes, nicks, abrasions, or any such physical damage which may have occurred during shipping, storage, or handling, which are deeper than 10 percent of the wall thickness shall not be used and shall be removed from the construction site.

C. Use wide belly band slings for lifting and moving pipe. Do not use bare chains in contact with pipe.

1.07 SUBMITTALS

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

B. Submit manufacturer's product data with complete information on pipeline materials, physical properties, and dimensions pertinent to this job. Furnish a certificate of compliance with specifications for materials to be supplied.

C. Submit test reports prepared by an independent testing laboratory certifying that polyethylene pipe conforms to the requirements of ASTM D1248 and ASTM D3350 or that fiberglass reinforced pipe (FRP) pipe conforms to requirements of ASTM D2992 and ASTM D3681, as applicable.

D. Submit manufacturer's product data on clamps.

E. Submit videotapes as specified in Section 02733.

1.08 TESTING

A. The City may run tests on field samples following applicable ASTM specifications at an independent laboratory to verify the required properties and characteristics of supplied materials. Provide product samples as requested by the Owner's Representative.

B. The City will pay for tests on liner material which meets specifications requirements. Contractor shall pay for failed tests and retesting of failed materials.

PART 2 P R O D U C T S

2.01 PIPE BURSTING/CRUSHING SYSTEMS

A. The manufactures/companies must be pre-approved by the Owner. Provide documentation detailing qualification, references, and experience for Owner approval.

2.02 MANUFACTURERS

A. Liner pipe systems shall be polyethylene or fiberglass reinforced plastic (FRP) products approved by the City.

B. Approved manufacturer for polyethylene liner is Chevron Phillips.

C. Approved manufacturer for FRP liner is Hobas USA, Inc.

2.03 POLYETHYLENE LINER PIPE AND FITTINGS

A. Provide polyethylene liner pipe, manufactured of solid wall, high density, high molecular weight, polyethylene compound conforming to ASTM D1248, Type III, Class B, Grade P-34, Category 5, with a PPI rating of PE 3408. Use Polyethylene material with a minimum cell classification of 345434D or E (inner wall of Light color) under ASTM D3350. A higher numbered cell classification limit which gives a desirable higher primary property, according to ASTM D3350, is also acceptable. Dimensions and workmanship shall be in accordance with ASTM F714 and ASTM D2122.

B. The maximum Standard Dimension Ratio (SDR), the ratio of outside diameter of pipe to wall thickness, is specified below. Select the SDR for the deeper of two manholes in a particular pipeline segment.

Existing Nominal Diameter (Inches)	Minimum Outside Diameter (Inches)	Minimum Wall Thickness (Inches)		
		15’ Deep	> 15 20’ Deep	>20’ Deep
		SDR 19	SDR 17	SDR 11
6-8	8.625	0.454	0.507	0.784
10	12.75	0.671	0.750	1.159
12	14.0	0.737	0.824	1.273
15	18.0	0.947	1.059	1.636
18	20.0	1.053	1.176	1.818

C. Before beginning work, the Contractor shall submit to the Owner’s Representative for approval, the vendor’s specific technical data with complete physical properties of pipe and pipe dimensions pertinent to this job.

2.04 FRP LINER PIPE AND FITTINGS

A. Provide liner pipe manufactured in conformance to the requirements of ASTM D3262, Type 1, Liner 2, Grade 3. Liner pipe shall be reinforced plastic mortar pipe manufactured by the centrifugal casting process resulting in a dense, nonporous, corrosion resistant, consistent, composite structure. FRP pipe shall have a minimum stiffness of 72 psi measured in accordance with ASTM D2412. Pipes with a stiffness greater than 72 psi may be used with approval of Owner’s Representative.

B. Resin systems shall be thermosetting polyester epoxy resin, with or without filler, producing a pipe conforming to requirements of ASTM D3262.

C. Reinforcing glass fibers shall be commercial grade, E-type glass filaments with binder and sizing compatible with impregnating resins.

D. Filler shall be sand with a minimum 98 percent silica content and a maximum moisture content of 0.2 percent.

E. Joints shall be low-profile FRP jacking bell-and-spigot joints with elastomeric sealing gaskets to produce watertight joint. Joints shall conform to the requirements of ASTM D4161.

F. Dimensions and Tolerances:

1. Pipe outside diameters and tolerances shall be in accordance with ASTM D3262, Cast Iron Pipe Equivalent Outside Diameters and the table below. Supply pipe in nominal lengths of 20 feet, when possible. Where radius curves in existing pipe or limitations in entry pit dimensions restrict pipe length, shorter lengths may be used.

2. The FRP pipe minimum outside diameter and minimum wall thickness shall be as specified in the following table:

Existing Sewer Nominal Diameter (Inches)	Minimum Liner O.D. (Inches)	Minimum Wall Thickness 46 psi Stiffness (Inches)	Minimum Wall Thickness 72 psi Stiffness (Inches)
12	13.45	0.34	0.48
15-18	19.50	0.34	0.48

3. Fabricated pipe ends square to pipe axis or minus 0.25, inches, or plus or minus 0.5 percent of nominal diameter, whichever is greater.

G. Flanges and Fittings: Flanges, elbows, reducers, tees, wyes, and other fittings shall be capable of withstanding operating conditions. Fittings shall be contact-molded or manufactured from mitered sections of pipe jointed by glass fiber reinforced overlays.

2.05 LINER PIPE SEAL AT MANHOLE

A. The annular space between liner pipe and host sewer at manhole shall be sealed with oakum strips soaked in Scotchseal 5600 as manufactured by 3M Corporation, or equal.

B. Grout mix shall be non-shrink grout.

2.06 CLAMPS AND GASKETS

A. Clamps shall be stainless steel, including bolts and lugs as manufactured by JCM Industries, Type 108, or equal. Furnish full circle, universal clamp couplings with a minimum 3/16-inch thick neoprene, grid-type gasket. Select clamps to fit outside diameter of liner pipe. Use minimum clamp (length) as specified in the following table:

Liner Pipe O.D. (Inches)	Minimum *(Length)* of Clamp (Inches)
8.625	18
10.750 or greater	30

2.07 BEDDING MATERIAL

A. Provide bedding conforming to requirements of Section 02227 and Section 02252.

PART 3 E X E C U T I O N

3.01 PRE-INSTALLATION PREPARATIONS

A. Contractor shall submit a work plan to the Owner's Representative for review and acceptance. The work plan shall address the following minimum preparation/steps, unless approved otherwise by the Owner's Representative.

1. Safety - The Contractor shall carry out operations under this Section in strict accordance with all applicable OSHA Standards. Particular attention is drawn to those safety requirements involving work on an elevated platform and entry into a confined space. It shall be the Contractor's responsibility to comply with OSHA Standards and Regulations pertaining to all aspects of the work.

2. Pre-Installation Television Inspection - It shall be the responsibility of the Contractor to video (TV) inspect the sewer pipe immediately before the pipe bursting/crushing to assure that the existing pipe conditions are acceptable for pipe bursting/crushing. This inspection, as well as the video (TV) inspection after the installation, shall be incidental to the installation of the replacement pipe.

3. Bypassing Sewage - When required for acceptable completion of the pipe bursting/crushing process, the Contractor shall provide for continuous sewage flow around the section(s) of pipe designated for the installation of replacement pipe. The pimp bypass lines shall be of adequate capacity and size to handle the flow in accordance with the applicable section.

4. Line Obstructions - If Pre-Installation video (TV) inspection reveals an obstruction in the existing sewer (heavy solids, dropped joints, protruding service taps or collapsed pipe) which will prevent completion of the pipe bursting/crushing process, and that cannot be removed by conventional sewer cleaning equipment, then an Obstruction Removal shall be made by the Contractor, with the approval of the Owner's Representative.

5. Sags in Line - If Pre-Installation video (TV) inspection reveals a sag in the existing sewer that is greater than one-half the diameter of the existing pipe, it shall be the Contractor's responsibility to install the replacement pipe to result in an acceptable grade without the sag. The Contractor shall take the necessary measures to eliminate these sags by digging a sag elimination pit and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipe invert or by other measures that shall be acceptable to the Owner's Representative. Elimination of sags in the line shall not be paid separately but shall be included in the unit price bid for pipe bursting/crushing.

3.02 BYPASS PUMPING

A. Refer to Section 02790 - Divergence Pumping.

3.03 INSERTION OR ACCESS PITS

A. Locate pits so that the total number is minimized and footage of liner pipe installed in a single pull is maximized. Use excavations at point repair locations for insertion pits, where possible.

B. Before excavating, check with various utility companies (e.g., CenterPoint Energy, AT&T, City, Texas Gas), and determine the location of utilities in the vicinity of the work area. For damage done to utilities, the resulting repair, temporary service, and other such costs shall be borne by Contractor.

C. Perform excavation and backfill in accordance with requirements of Section 02227.

D. Perform work in accordance with OSHA standards. Follow requirements specified in Section 01526 - Trench Safety System.

E. Install and operate necessary dewatering and surface water control measures in accordance with specifications.

3.04 PIPE INSTALLATION

A. The Contractor shall submit information, in detail, of the procedure and the steps to be followed for the installation of the pipe bursting/crushing system selected, even in the process is named in the specification. All such instructions and procedures

submitted shall be carefully followed during installation. Any proposed changes in installation procedures shall require submittal of revised procedures and acceptance by the Owner's Representative.

1. Finished Pipe - The installed replacement pipe shall be continuous over the entire length of each pipe segment from manhole to manhole and shall be free from visual defects such as foreign inclusions, concentrated ridges, discoloration, pitting, varying wall thickness, pipe separation other deformities. Replacement pipe with gashes, nicks, abrasions, or any such physical damage which may have occurred during storage and/or handling, shall not be used and shall be removed from the construction site. The replacement pipe passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by the Owner's Representative. The invert and benches shall be streamlined and improved for smooth flow. The installed pipe shall meet the leakage requirements of the pressure test specified later.

2. Process Limitations - Though the installation process may be licensed or proprietary in nature, the Contractor SHALL NOT change any material, thickness, design values or procedural matters stated or approved in the submittals, without the Owner's Representative's prior knowledge and preapproval. The Contractor shall submit, in writing, full details about component materials, their properties and installation procedures and abide by them fully during the entire course of the project.

   All sewer rehabilitation by pipe bursting/crushing systems are being considered structurally equal processes as far as "end product" required by the City. The minimum required performance criteria, and/or standards, physical/structural properties, chemicals resistance tests, and the replacement pipe thickness as given in this Specification shall be strictly complied. It shall be the responsibility of the Contractor to comply with the specifications in full without any request for any change after the award of the contract. The City reserves the right to accept, reject, or modify any later requests for change at no additional cost to the City or even to the extent of asking credit for the City.

B. Pipe Jointing

1. Polyethylene Pipe - Sections of polyethylene replacement pipe shall be assembled and jointed on the job site above the ground. Jointing shall be accomplished by the heating and butt-fusion system in strict conformance with the manufacturer's printed instructions.

The butt-fusion system for pipe jointing shall be carried out in the field by operators with prior experience in fusing polyethylene pipe with similar equipment using proper jigs and tools per standard procedures outlined by the pipe manufacturer. These joints shall have a smooth, uniform, double rolled back head made while applying the proper melt, pressure and alignment. It shall be the sole responsibility of the Contractor to provide an acceptable butt-fusion joint. All joints shall be made available for inspection by the Owner's Representative before insertion. The replacement pipe shall be joined on the site in appropriate working lengths near the insertion pit. The maximum length of continuous replacement pie which shall be assembled above ground and pulled on the job site at any on time shall be 600 linear feet.

2. Centrifugally Cast Fiberglass Pipe - Sections of centrifugally cast fiberglass pipe shall be manufactured with an integral straight bell, gravity jacking bell-spigot joint. This joint shall be affixed to one end of the pipe by the manufacturer.

An elastomeric gasket, supplied by the manufacturer, shall be placed on the groove of the spigot, just prior to installation. The gasket shall be properly seated, then lubricated per manufacturer's instruction. All joints shall be made available for inspection by the Owner's Representative before insertion. The replacement pipe shall be jointed in or near the insertion pit.

C. Preparation: After completing insertion pit excavation, remove top of existing sanitary sewer line down to the spring line. Connect a Pipe Bursting/Crushing system to the end of liner by use of a suitable pulling head equal to or greater than the outside diameter of liner. Secure pulling head to liner and attach to Pipe Bursting/Crushing system so that liner can be satisfactorily fed and pulled through sanitary sewer main. Prevent ragged edges of existing pipe from scaring liner pipe. Refer to insertion procedures given in ASTM F585. Do not allow sand or other debris to enter the liner.

D. Pulling Liner:

1. The maximum length of continuous liner which may be assembled above ground and pulled at any one time is the length recommended by the manufacturer's printed instructions.

2. Limit the pulling force exerted on liner so that the forces indicated below for the device connected to the winch or pulling mechanism.

Polyethylene Liner O.D. (Inches)	Maximum Pulling Force (Tons)
8.625	6.0
10.75	10.0
14.0	17.0
16.0	23.0
18.0	28.0

3.05 FRP LINER PIPE INSTALLATION

A. FRP liner pipes may be pulled into the existing sewer. Insert the pipes, spigot end first, with the bell end trailing. Apply pushing force to pipe wall end inside of bell in accordance with manufacturer's instruction. Do not ally a jacking load to end of bell. Maximum allowable joint angular deflection shall be 1.0 degree. Keep within safe jacking loads given in the following table:

Outside Diameter (Inches)	Maximum Jacking Load (Tons) For 72 psi Stiffness
13.45	22
17.40	30

3.06 CLAMP INSTALLATION

A. Where excavation for liner pipe insertion are made between two manholes, cut ends of the liner pipe smooth, square to its axis. Join liner pipes with approximately sized stainless steel universal clamp couplings. Gap between ends of liner pipe shall be butted together with space between ends not exceeding 2 inch.

B. Bedding shall be stabilized cement sand conforming to requirements of Section 02252 - Cement Stabilized Sand. Bedding shall extend 12" above the clamp/liner pipe.

3.07 FRP COLLAR/CLOSURE

A. FRP collar closure pieces shall be installed in accordance with manufacturer's recommendations.

3.08 FIELD QUALITY CONTROL

A. All costs for testing the replacement pipe by a pressure method will be incidental to the installation. Two types of testing shall be required after the replacement pipe has been installed in the existing sanitary sewer main. The first is a low-pressure air test of the replacement pipe before it has been sealed in place at the manholes, and before any service reconnections have been made. The purpose of this test is to check the integrity of the joints that have been made and to verify that the replacement pipe has not been damaged by inserting it into the sanitary sewer. The second test is a service lateral connection test in accordance with the Section 02762 - Sanitary Sewer Service Reconnections. The test shall be done after all service laterals have been made for a particular pipe segment between adjacent manholes. This test shall verify the integrity of the connection at the point where it joins the replacement pipe and existing service line.

B. Low Pressure Air Test Procedure - Refer to Section 02732 - Acceptance Testing for Sanitary Sewers.

3.09 SEALING LINER MANHOLE

A. Allow liner pipe to normalize to ambient temperatures as well as recover from imposed stretch before cutting to fit between manholes, sealing at manholes, and manhole invert shaping. Normalization usually takes at least 12 hours for polyethylene.

B. Cut liner so that it extends 4 inches into manhole. Make a smooth, vertical cut and slope area over top of exposed liner using non-shrink grout.

C. Seal the annular space between liner and sanitary sewer main at each manhole with a chemical seal and nonshrink grout. Place strips of oakum soaked in sealer in a band to form an effective watertight gasket in the annular space between liner and existing opening in manhole. Make width of the sealing band a minimum of 8 inches or the thickness of the manhole wall, whichever is greater.

D. Finish seal with a non-shrink grout placed around annular space from inside manhole. Apply grout in a band not less than 6 inches wide.

E. Reshape and smooth the manhole invert as specified in Section 02764 - Manhole Rehabilitation. Use approved manhole rehabilitation material to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channels invert. Build up and smooth invert of manhole to match flow line of new liner.

F. The replacement pipe in the manhole shall be sealed as specified above before processing on to the next manhole section and all manholes shall be individually inspected for replacement pipe cut-offs, benches, and sealing work.

G. Payment by work described above shall be incidental to the unit price bid for pipe bursting/crushing.

3.10 POST INSTALLATION TELEVISING OF COMPLETED WORK

A. The Contractor shall provide the City a color video tape taken by a pan and tilt pipe inspection camera that pans 275 and rotates 360 for close up view showing the completed work, including the condition of the restored service connections.

B. Television inspections, tapes and reports, etc., shall be in accordance with Section 02733 - Cleaning and Television Inspection. Upon completion of the installation work and testing, the Contractor shall restore/clear the project area affected by his operations. No trash, rubbish, etc., shall be stored at any site, whether the work is in progress or not.

3.11 FINAL CLEANUP

A. Upon completion of installation work and testing, clean and restore project area affected by the Work. Restoration shall be in accordance with the specifications.

END OF SECTION

SECTION 02769

OBSTRUCTION REMOVAL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

This section includes clearing the sewer main from obstructions by one for the following methods:

A. Obstruction removal by remote device

1. To remove protruding taps (service lines that protrude greater that 1-inch into the sewer)

2. To remove other obstructions

B. Obstruction removal by excavation

1.02 UNIT PRICES

A. Obstruction removal by excavation will be paid per bid item. Depth is measured from the ground level to the flow line of the sanitary sewer main at the point of the obstruction removal. The payment for an obstruction removal shall be made when the Contractor has cleared the obstruction from the sewer main to be lined as directed by the Owner's Representative. The unit price for obstruction removal by excavation shall include a minimum length twelve (12) feet for all pipe sizes and depths. The depth ranges indicated in the bid proposal for the minimum length of pipe removed by obstruction removal by excavation is 0 to 5-feet deep, 6-feet to 10-feet deep, 11-feet to 15-feet deep and over 15-feet deep. In the event the section of pipe removed is greater than the minimum length (12-feet), payment for additional footage of pipe shall be paid for as per the bid item "Extra Length Obstruction Removal" per linear foot for all pipe sizes, and depths.

B. Obstruction removal by remote device shall be paid per bid item. Obstruction removal by remote device for protruding taps shall be paid per bid item for each protruding tap removed. Obstruction removal by remote for other obstructions shall be paid per bid item for each setup. A setup consists of one or more manhole section up to a continuous length of 800-feet provided that one or more removals are accomplished in each setup.

C. Any cleaning of sanitary sewer due to broken pipe, roots, dirt, and loose deposits, etc. will be incidental to obstruction removal by both methods. If any TV inspection is involved, it will be incidental.

D. Removal and legal disposal of hard deposits, concrete, debris, pipes or any other material in the manhole or that is within outside wall of the manhole wall will be incidental to the rehabilitation of sanitary sewer pipes and manholes.

E. Any bypass pumping associated with obstruction removal shall be considered incidental to the cost of the liner.

F. When extra length for obstruction removal by excavation occurs under pavement, the pavement removal and replacement and cement stabilized sand backfill shall be incidental.

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 OBSTRUCTION REMOVAL BY REMOTE DEVICE

A. This method of obstruction removal shall be performed prior to rehabilitation. When a T.V. tape of televised sanitary line identifies an obstruction which could cause a non-uniform liner pipe or obstruction during installation of the liner, it shall be removed. The Contractor shall ask the Owner's Representative for approval of obstruction removal with a remote device using one of the following:

B. To remove protruding taps prior to the rehabilitating with a liner, a power driven cutting device shall be utilized. The protruding tap shall be cut so that the protrusion is no greater than ¼ inch. In the event damage to the existing sewer line or service line occurs, a repair shall be done at the Contractor's expense and only a payment for the remote obstruction removal will be made. If the Contractor is unable to remove the protruding tap by this means, then a point repair may be performed at the Owner's Representative's direction.

C. To remove other obstructions, such as hanging gaskets, fixed debris, stabilized sand, hardened mineral deposits(includes tuberculation in cast or ductile iron pipes), heavy roots, etc., a remote device shall be utilized. The device(s) shall be pulled or driven from manhole to manhole up to a continuous length of 800-feet using a solid steel mandrel, porcupine, root saw, bucket, etc. to remove the obstruction. The device shall be adequately sized to remove the obstruction to the satisfaction of the Owner's Representative. Damage to the existing sewer line, service line or tap must be repaired by the Contractor and only a payment for remote obstruction removal will be made. The mechanical cleaning method, as described in Section 02733, may be used to remove the obstruction when approved by the Owner's Representative. No separate payment shall be made for utilizing mechanical cleaning method to remove the obstructions. The Contractor shall be paid at the bid unit price for performing obstruction removal (other) irrespective of the method utilized to remove obstruction. Damage to the existing sewer line, service line or tap must be repaired by the Contractor at his expense. The cleaning of the pipe in preparation for rehabilitation is not considered obstruction removal.

3.02 OBSTRUCTION REMOVAL BY EXCAVATION

A. This method of obstruction removal shall be performed while installing the liner in sanitary sewer. If during the liner insertion operation, a collapsed sewer, off-set joint, or other obstruction is encountered which prevents or blocks the passage or insertion of any

liner involved in the rehabilitation process, the Contractor shall notify the Owner's Representative for approval to make an excavation to uncover and remove the obstruction in the following manner:

1. Excavate at the point where there is an obstruction. A trench safety system shall be required for all excavations over 5-feet deep.

2. Break out the existing sanitary sewer pipe (carrier pipe), etc., as directed by the Owner's Representative. Remove only that amount of material which is causing the obstruction. The amount of "carrier pipe" to be removed shall be minimized. The minimum length of pipe to be removed shall be six (6) feet for all depths.

3. When the liner is completely in place, it shall be encased with cement stabilized sand as per Class "AA" modified bedding.

4. When obstruction removal by excavation occurs under a paved area, then backfill shall be cement stabilized sand.

B. Under such conditions, replacement of the carrier pipe is not required. The existing sewer bedding should not be disturbed by the excavation work. However, if said bedding is disturbed during the obstruction removal procedure, the Contractor shall place cement stabilized sand beneath the liner; the minimum compacted thickness shall be 12-inches.

END OF SECTION

SECTION 02790

DIVERSION PUMPING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Use of by-pass pumping to prevent surcharging and maintain un-interrupted flow through sewage collection system while allowing Contractor to provide reliable sewer service to the sanitary sewer users at all times and to isolate sewer line manholes and/or sewer line segments designated for cleaning, rehabilitation, and television inspection operations. Includes installation and operation of bulkheads, plugs, hoses, piping and pumps to maintain sewage flow and prevent backup and overflow.

1.02 UNIT PRICES

A. No separate payment for work performed under this item, unless stated in the bid proposal. Include cost of same in contract price bid for items of work which it is a component.

PART 2 M A T E R I A L S

2.01 PUMPS

A. When well-pointing in residential areas, utilize noise reducing pumps and said pumps must be approved by the Owner.

B. Pumps and/or generators must be provided with noise attenuators when pumping is required after hours.

2.02 PIPING, JOINTS AND ACCESSORIES

A. All piping, joints and accessories shall be designed to withstand at least twice the maximum system pressure or a minimum of 50 psi which ever is greater and be leak free.

PART 3 E X E C U T I O N

3.01 PROCEDURES AND METHODS

A. Prior to beginning sewer cleaning, rehabilitation and television inspection operations demonstrate pumping system is in good working order.

B. Prior to isolating sewer manhole and/or line segment for beginning work have all materials, equipment and labor necessary to complete sewer on job site.

C. Locate pumping suction and discharge lines so as not to cause undue interference with the use of streets, private driveways entrances or residences.

D. All piping, joints and accessories shall be designed to withstand at least twice the maximum system pressure or a minimum of 50 psi whichever is greater.

E. Plug off and pump down sewer manhole or line segment in designated area. Maintain sanitary sewer system so that surcharging does not occur.

F. Complete sewer cleaning, rehabilitation and television inspection operations as quickly as possible.

G. An experienced operator shall be on site at all times to monitor the operation, adjust pump speed, valves, etc.

H. Furnish all labor, materials, supervision and equipment necessary for maintaining the pumping system in continuous proper working order for the duration of cleaning, rehabilitation and television inspection operations. Obtain approval of discharge location for diversion pumping system prior to commencing work. Under no condition will raw sewage be allowed to discharge in open ditches, streets, or storm sewer systems or in any way that would create unsanitary conditions or interfere unduly with the use of streets, private driveways entrances or residences. Whenever flows in a sewer line are blocked, plugged or bypassed, sufficient precautions must be taken to protect the sewer lines from damage. Ensure that sewer line cleaning, rehabilitation and television inspection and/or by-pass operations do not cause flooding or damage to public or private property being served by the sewer lines involved in the repair. The Contractor is responsible for having additional stand by pumps in the event of failure of any pumps.

I. In the event sewage accidentally drains into the drainage system or street, the Contractor shall immediately stop the overflow, notify the Owner's Representative and cleanup and disinfect the spillage to the satisfaction of the Owner's Representative.

1. In the event the sewage is spilled onto public or private property, the Contractor shall wash down, clean up and disinfect the spillage to the private owner's/ Owner's Representative satisfaction.

2. Overflow/spillage shall be reported to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA) by the Contractor within 24 hours.

J. When diversion pumping operations are complete, piping shall be drained into the sanitary sewer prior to disassembly.

END OF SECTION

SECTION 02831

CHAIN LINK FENCES AND GATES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Fence framework, fabric, and accessories.

B. Excavation for post bases, concrete foundation for posts and center drop for gates.

1. Manual gates and related hardware.

1.02 MEASUREMENT AND PAYMENT

A. Payment for fencing shall be on a linear foot basis for height noted.

B. Payment for gates shall be per unit.

1.03 SYSTEM DESCRIPTION

A. Fence Height shall be as indicated on Drawings or as noted to match height of existing.

B. Extension arms for barbed wire shall match existing.

C. Line Post Spacing shall not exceed 10 feet, or as shown on Drawings.

1.04 SUBMITTALS

A. Submit in accordance with all sections and provisions of these specifications.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

C. Product Data: Provide data on fabric, posts, accessories, fittings and hardware that indicates that items match or exceed the quality of existing.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

1.06 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 P R O D U C T S

2.01 GALVANIZED FENCING

A. Fence fabric shall be No. 9 steel wire, hot galvanized after weaving, to match or exceed existing.

B. Framework shall be hot-dipped galvanized with a minimum coating of 2 ounces/sf, or one ounce/sf plus 30 micrograms/square inch chromate conversion coating.

C. Line posts shall conform to ASTM A570 Grade 45 steel or ASTM A569, cold rolled steel.

D. End corner, angle, and pull posts shall conform to ASTM A570 Grade 45 steel or ASTM A569 for steel pipe.

E. Top rails shall be 1.65 x 1.25-inch formed C-section; or 1.6-inch round ASTM A569, 1.35 lbs/ft; or 1-5/8-inch outside diameter steel pipe, 2.27 lbs/ft. Top rails shall pass through openings provided for that purpose in post tops.

F. Fabric ties shall be hog rings, galvanized steel wire not less than 9-ga with a zinc coating of not less than 1.2 ounces/sf.

G. Bolts and nuts shall be in conformance with ASTM A307 and shall be galvanized in accordance with AASHTO M232.

H. Install horizontal braces fabricated of 1-5/8-inch, 2.27-lb copper bearing steel pipe at all corner, gate, and end posts.

I. Gates shall be either swing or slide as shown on the plans. Swing gates shall be hinged to swing 90 degrees from closed to open or hinged to swing 180 degrees from close to open. Slide gates shall be roller type with no vertical obstructions. All gate leaves shall have intermediate members and diagonal stress rods as required for rigid construction and shall be free from sag or twist. All gates shall be fitted with vertical extension arms or shall have frame end number extended to carry barbed wire. Gateposts for gates shall be 4-inch, 9.1 lb pipe. Gate frames shall be made of 2-inch outside diameter, castings. Fabric shall be the same as for the fence. Gates shall have malleable iron ball and socket hinges, catches, stops and padlocks with 3 keys each. Posts for single gates shall be the same as end posts.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install chain link fence in accordance with the directions of the manufacturer and these Specifications.

B. Install fence posts at not more than 10-ft centers and at least 36 inches into the ground in a Class B concrete base. Allow concrete to cure for at least 7 days before erecting remainder of fence. Fasten fabric to line posts with wire ties spaced about 14 inches apart and to top rail spaced about 24 inches apart.

C. Use standard chain link fence stretching equipment to stretch the fabric before tying it to the rails and posts. Repeat the stretching and tying operations about every 100 feet.

D. Erect gates so they swing or slide in the appropriate direction. Provide gate stops as required. Secure hardware, adjust, and leave in perfect working order. Adjust hinges and diagonal bracing so that gates will hang level. Adjust rollers and guides of sliding gates so that gates are level.

E. At small natural or drainage ditches where it is not practical for the fence to conform to the contour of the ground, span the opening below the fence with wire fastened to stakes of required length. The finished fence shall be plumb, taut, true to line and ground contour. When directed, stake down the chain link fence at several points between posts.

F. Where new fence joins an existing fence, set a corner post and brace post at the junction and brace as directed. If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace.

G. Slats shall be used when specified on the drawings.

END OF SECTION

SECTION 02920

TOPSOIL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Furnishing and placing topsoil for finish grading and for seeding, sodding and planting.

1.02 UNIT PRICES

A. No separate payment will be made for topsoil. Include payment in Section 02932 - Hydromuch Seeding and Section 02935 - Sodding.

PART 2 P R O D U C T S

2.01 TOPSOIL

A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having the following characteristics:

1. pH value of between 5.5 and 6.5.

2. Liquid limit: topsoil not exceed 50

3. Plasticity index: 10 or less.

4. Gradation: maximum of 40 percent with a passing the #280 sieve.

B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.

C. Obtain topsoil from naturally well-drained areas where topsoil occurs at a minimum depth of 4 inches and has similar characteristics to that found at the placement site. Do not obtain topsoil from areas infected with a growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify that excavation and embankment operations have been completed to correct lines and grades.

3.02 TOPSOIL EXCAVATION

A. Conform to excavation and stockpiling requirements of section 02225 - Roadway Excavation.

3.03 PLACEMENT

A. For areas to be seeded or sodded, scarify or plow existing material to a minimum depth of 4 inches, or as indicated on the Drawings. Remove any vegetation and foreign inorganic material. Place 4 inches of topsoil on the loosened material and roll lightly with an appropriate lawn roller to consolidate the topsoil.

B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Section 02229 - Utility Backfill Material.

C. For areas to receive bushes or trees, excavate existing material and place topsoil to the depth and dimensions shown on the Drawings.

D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Section 01564 - Waste Material Disposal.

3.04 PROTECTION

A. Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION

SECTION 02932

HYDROMULCH SEEDING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Seeding, fertilizing, mulching, and maintenance of areas indicated on Drawings.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this Section unless unit cost is included in the Bid Proposal. Include cost for such work in unit cost for utility in the Bid Proposal.

1.03 SUBMITTALS

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

B. Submit certification from supplier that each type of seed conforms to these specification requirements and the requirements of the Texas Seed Law. Certification shall accompany seed delivery.

C. Submit a certificate stating that fertilizer complies with these specification requirements and the requirements of the Texas Fertilizer Law.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Topsoil: Conform to material requirements of Section 02920 - Topsoil.

B. Seed: Conform to U.S. Department of Agriculture rules and regulations of the Federal Seed Act and the Texas Seed Law. Seed shall be certified 90 percent pure and furnish 85 percent germination and meet the following requirements:

1. Rye: Fresh, clean, Italian rye grass seed (lollium multi-florum), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.

2. Bermuda: Extra-fancy, treated, lawn type common bermuda (Cynodon dactylon). Deliver in original, unopened container showing weight, analysis, name of vender, and germination test results.

3. Wet, moldy, or otherwise damaged seed will not be accepted.

4. Seed requirements, application rates and planting dates are:

Type	Application Rate Pounds/A	Planting Date
Hulled Common Bermuda Grass 98/88	40	Jan 1 to Mar 31
Unhulled Common Bermuda Grass 98/88	40	
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88	40	Oct 1 to Dec 31
Unhulled Common Bermuda Grass 98/88	40	
Annual Rye Grass (Gulf)	30	

C. Fertilizer: Dry and free flowing, inorganic, water-soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear the manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of the following elements:

Nitrogen	10 Percent
Phosphoric Acid	20 Percent
Potash	10 Percent

D. Mulch: Virgin wood cellulose fibers from whole wood chips having a minimum of 20 percent fibers 0.42 inches (10.7 mm) in length and 0.01 inches (0.27 mm) in diameter. Mulch shall be dyed green for coverage verification purposes.

E. Soil Stabilizer: "Terra Tack" 1 or approved equal.

F. Weed control agent: Pre-emergent herbicide for grass areas, "Benefin" or approved equal.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Place and compact topsoil in accordance with requirements of Section 02920 - Topsoil.

3.02 APPLICATION

A. Seed: Apply uniformly at rates given in Paragraph 2.01 B for type of seed and planting date.

B. Fertilizer: Apply uniformly at a rate of 500 pounds per acre.

C. Mulch: Apply uniformly at a rate of 50 pounds per 1000 square feet.

D. Soil stabilizer: Apply uniformly at a rate of 40 pounds per acre.

E. Weed control agent: Apply at manufacturer's recommended rate prior to hydromulching.

F. Suspend all operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold with Owner' approval. Obtain the Owner's Representative's approval before resuming operations.

3.03 MAINTENANCE

A. Maintain grassed areas a minimum of 90 days, or as required to establish an acceptable lawn with 85% coverage. No acceptance will be given until coverage is at least 85%. For areas seeded in the fall, continue maintenance the following spring until an acceptable lawn is established.

B. Maintain grassed areas by watering, fertilizing, weeding, and trimming.

C. Repair areas damaged by erosion by regrading, rolling and replanting.

END OF SECTION

SECTION 02935

SODDING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Restoration of existing lawn areas disturbed by construction shall be by installation of new sod.

B. Sod is defined as blocks, squares, strips of turf grass, and adhering soil used for vegetative planting. To be placed edge to edge for complete coverage.

C. Lawn is defined as ground covered with fine textured grass kept neatly mowed.

1.02 UNIT PRICES

A. No separate payment will be made for work performed under this section unless unit cost is included in the Bid Proposal. Include the cost of such work for restoration of the existing sod or lawn areas in unit cost for utility and paving items in the Bid Proposal.

1.03 SUBMITTALS

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

1.04 QUALITY ASSURANCE

A. Perform sodding only when weather and soil conditions are deemed by Project Owner's Representative to be suitable for proper placement.

B. Water and fertilize new sod.

C. Guarantee sod to be growing 30 days after completion.

D. Maintenance Period:

1. Begin maintenance immediately after each section of grass sod is installed and continue for a 30-day period from date of substantial completion.

2. Resod unacceptable areas.

3. Water, fertilize, control disease and insect pests, mow, edge, replace unacceptable materials, and perform other procedures consistent with good horticultural practice to ensure normal, vigorous and healthy growth. All disease control shall be installed within guidelines set forth by the Structural Pest Control Board of the State of Texas.

E. Notify Owner's Representative 10 days before end of maintenance period for inspection.

PART 2 P R O D U C T S

2.01 SOD

A. Species: Bermuda (Cynodon Dactylon), Buffalo (Buchloe Dactyloides), or St. Augustine.

B. Contents: 95 percent permanent grass suitable to climate in which it is to be placed; not more than 5 percent weeds and undesirable grasses; good texture, free from obnoxious grasses, roots, stones and foreign materials. Block sod is usually a 16" x 16" square.

C. Size: 16 inch wide strips, uniformly 2 inches thick with clean-cut edges.

D. Sod is to be supplied and maintained in a healthy condition as evidenced by the grass being a normal green color.

2.02 FERTILIZER

A. Available nutrient percentage by weight: 12 percent nitrogen, 4 percent phosphoric acid, and 8 percent potash; or 15 percent nitrogen, 5 percent phosphoric acid, and 10 percent potash.

2.03 WEED AND INSECT TREATMENT

A. Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to the Owner's Representative for approval. All insect and disease control shall be installed within guidelines set forth by the Structural Pest Control Board of the State of Texas.

2.04 WATER

A. Potable, available on-site through Contractor's water trucks. Do not use private resident's water.

2.05 BANK SAND

A. Free of clay lumps, roots, grass, salt or other foreign material.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify that top soil placement and compaction has been satisfactorily completed. Verify that soil is within allowable range of moisture content.

B. Topsoil shall be free of weeds and foreign material immediately before sodding.

C. Do not start work until conditions are satisfactory. Do not start work during inclement or impending inclement weather.

D. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions.

E. Spread 2-inch layer of bank sand over areas to be sodded prior to planting of sod.

F. Apply fertilizer at a rate of 25 lbs/1000 SF. Apply after raking soil surface and not more than 48 hours prior to laying sod. Mix thoroughly into upper 2 inches of soil. Lightly water to aid in dissipation of fertilizer.

3.02 APPLICATION

A. Lay sod with closely fitted joints leaving no voids and with ends of sod strips staggered. Sod shall be laid within 24 hours of harvesting.

B. After sod is laid, irrigate thoroughly to secure 6-inch minimum penetration into soil below sod.

C. Tamp and roll sod with approved equipment to eliminate minor irregularities and to form close contact with soil bed immediately after planting and watering. Submit type of tamping and rolling equipment to be used to the Owner's Representative for approval, prior to construction.

3.03 MAINTENANCE

A. Watering:

1. Water lawn areas once a day with minimum 1/2 inch water for the first 3 weeks after area is sodded.

2. After 3-week period, water twice a week with 3/4 inch of water each time unless comparable amount has been provided by rain.

3. Make weekly inspections to determine moisture content of soil unless soil is in frozen condition.

4. Water in the morning to enable soil to absorb maximum amount of water with minimum evaporation.

B. Mowing:

1. Mow sod at intervals which will keep grass height from exceeding 3-1/2 inches.

2. Set mower blades at 2-1/2 inches.

3. Not remove more than one-half of grass leaf surface.

4. Sodded areas requiring mowing within 1 month after installation shall be mowed with a light-weight rotary type mower. The sod shall be mowed only when dry and not in a saturated or soft condition.

5. Remove grass clippings during or immediately after mowing.

C. Fertilizer and Pest Control:

1. Evenly spread fertilizer composite at a rate of 40 pounds per 5,000 square feet or as recommended by manufacturer. Fertilizer shall not be placed until 2 weeks after placement of sod.

2. Restore bare or thin areas by topdressing with a mix of 50 percent sharp sand and 50 percent sphagnum peat moss.

3. Apply mixture 1/4 to 1/2 inch thick.

4. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.

3.04 CLEANUP

A. During course of planting, remove excess and waste materials; keep lawn areas clean and take precautions to avoid damage to existing structures, plants, grass and streets.

B. Remove barriers, signs and all other Contractor material and equipment from project site at termination of establishment period.

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 03240

FIBROUS REINFORCING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Fibrous concrete reinforcement for shrinkage control.

1.02 UNIT PRICES

A. No payment will be made for fibrous reinforcing under this Section. Include payment in unit price for concrete.

1.03 SUBMITTALS

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

B. Submit manufacturer's product data indicating proposed fibrous concrete reinforcement materials for approval. Include documentation of performance history, compliance with applicable building codes, and ASTM C1116 Type III 4.1.3.

C. Submit manufacturer's batching and mixing instructions; and recommended quantity, in pounds of fiber per cubic yard, to be added to each type and strength of concrete.

D. Submit test data for design mixes in accordance with requirements of Sections 02521. Include results of tests accomplished in accordance with ASTM C94 and ASTM C1116 Type III 4.1.3; and ASTM C1116 (reference ASTM C1018) Performance Level I, outlined in Section 21 Note 7.

PART 2 P R O D U C T S

2.01 FIBROUS CONCRETE REINFORCEMENT

A. Supply 100 percent virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement. Materials shall not contain reprocessed olefin.

B. Provide fibrous concrete reinforcement materials to produce requirements for each type and strength of concrete designated. Minimum fiber reinforcement content shall be 1.5 pounds per cubic yard of concrete.

C. Physical characteristics:

1.	Specific gravity	0.91
2.	Tensile strength	80 - 110 ksi.
3.	Fiber lengths	Graded per manufacturer's recommendation.

PART 3 E X E C U T I O N

3.01 MIXING

A. Add fibrous concrete reinforcement to concrete materials at the time concrete is batched. Amounts shall conform to approved Submittals for each type of concrete required.

B. Mix batched concrete in accordance with fibrous concrete reinforcement manufacturer's instructions and recommendations. Attain uniform and complete distribution of fiber reinforcement.

3.02 PLACING AND FINISHING

A. Place and finish concrete materials in accordance with requirements of Sections 02521. Finish to minimize protruding fibers.

3.03 FIELD QUALITY CONTROL

A. Provide services of a qualified technical representative to instruct concrete supplier in proper batching and mixing of materials to be provided.

B. Submit certificates prepared by concrete supplier indicating amount of approved fibrous concrete reinforcement material added to each batch of concrete delivered to project site.

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 15030

LIFT STATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Electric Submersible Sewage Pumps and Motors

1. Acceptable manufacturers: Flygt and ABS. See specification Section 15032 Submersible Wastewater Pumps.

2. Pump Data Plate:
   a. Stainless steel, mechanically attached to pump containing manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data

3. Access Frame and Cover:
   a. Designed and installed to allow removal or installation of each pump unit to discharge connection in simple linear downward motion without interference
   b. As designed by manufacturer
   c. Covers:
      1) Lift station: Aluminum, diamond patterned wet well entry door, aluminum or stainless steel hinges provided with lifting handle, safety latch to hold door in open position and locking hasp

      2) Valve pit: Aluminum, diamond patterned valve pit entry door

B. Hydraulic Submersible Wastewater Pumps and Diesel Power Units.

1. Acceptable manufacturers: Selwood and Godwin. See specification Section 15033 Hydraulic Submersible Pump with Automatically Controlled Diesel Hydraulic Power Unit.
   a. Pump Data Plate
      Stainless steel, mechanically attached to pump containing manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.
   b. Access Frame and Cover:
   c. Designed and installed to allow removal or installation of each pump unit to discharge connection in simple linear downward motion without interference
   d. As designed by manufacturer
   e. Covers:

1) Lift station: Aluminum, diamond patterned wet well entry door, aluminum or stainless steel hinges provided with lifting handle, safety latch to hold door in open position and locking hasp

C. Piping and Valves

1. Well Piping. See Specifications Section 15053 Lift Station Piping.
   a. Wet Well penetrations shall be made with Link Seal Model S-316 with EPDM rubber, or approved equal. Bolts shall be ANSI Type = 316, Per ASTM F593-95 Tensile Strength = 85,000 psi, average.
      1) For cast in place penetrations of diameters up to 24.81" install molded non-metallic high density polyethylene sleeves (HDPE) with integral hollow, molded water-stop ring four inches larger than the outside diameter of the sleeve itself.
      2) For cast in place penetrations of diameters from 29.25" to 64.74" in diameter, use a modular hole-forming system consisting of interlocking HDPE plastic disc.
      3) For core drilled holes without sleeve consult manufacturer.

2. Control Panel and Electrical Equipment. See specifications in Division 16 of this Contract.
   a. House controls in NEMA 3R stainless steel weatherproof enclosure with gasketed door
   b. Equipped for 240 or 480 volts, as shown on electrical drawings, three-phase supply required
   c. Provide painted steel dead front inner door
   d. Provide modular subpanel with the following equipment:
      1) One main circuit breaker
      2) Heavy-duty molded case motor circuit breakers for each pump
      3) Across-line magnetic motor starters with individual thermal overloads for each pump
      4) One 120 volts control system
      5) Heavy duty hand/off/automatic selector switches for each pump
      6) One heavy duty control circuit breaker
      7) One solid-state pump alternator with test switch
      8) One duplex receptacle with breaker
      9) Pump run indicator lights for each pump
      10) One lighting arrestor system

11) One phase monitor system

12) Run time meters for each pump

13) One high level and one low level alarm light with test switches

14) One manual transfer switch with provision for a generator receptacle to be installed by others

15) Pedestal mounting kit

16) Space heater with humidistat control

17) Provisions for SCADA System

3. Liquid Level Sensors. See specifications in Division 16 of this Contract.
   a. Liquid level sensors with length of electrical cables, adjustable for future liquid level sensing requirements
   b. Non-floating displacement type, rated for operation of milliwatt levels

4. Pump Motor Cables, Float Control Cables. See specifications in Division 16 of this Contract. Any electrical wiring to be terminated outside of wet well in junction box or in control panel

5. Materials. See specifications in Division 16 of this Contract.

6. Wiring. See specifications in Division 16 of this Contract.
   a. Copper
   b. Conduit: Rigid steel

7. Coatings. See specifications Section 15053 Lift Station Piping and Section 02629 Poly urethane Coatings on Steel and Ductile Iron Pipe.

8. Emergency Call-Out Equipment. See specifications in Division 16 of this Contract.
   a. "RACO" Verbatim Autodialer

9. Intruder-Resistant Fencing
   a. Six-foot high, 2 inch pattern, zinc chromate conversion galvanized hot dip coated chain link fence. PVC coated after weaving with colored PVC slats and 3-strand barbed wire on top.
   b. (or) Eight-foot cedar fence, if shown on drawings, supported on galvanized steel posts, braces and rails, all secured by screws and bolts.
   c. Gates: Two six-foot or eight-foot tall, as shown on drawings, gates minimum of six feet wide sliding or hinged on 4" inch galvanized schedule 40 steel posts. Materials to match fencing.

END OF SECTION

SECTION 15032

SUBMERSIBLE WASTEWATER PUMPS

PART 1 G E N E R A L

1.01 SCOPE

This section provides for providing and installing submersible wastewater pumps with electric motors, controls, and accessories. Diesel powered hydraulically operated submersible wastewater pumps are provided for in specification Section 15033.

1.02 PAYMENT

No separate payment will be made for equipment and work performed under this section. Include the cost of such equipment and work in the bid item unit price for which this is related.

1.03 QUALITY ASSURANCE

Provide highest quality workmanship and materials throughout. Furnish standard equipment from a manufacturer with at least five (5) years of experience in the design and assembly of water and wastewater treatment equipment.

1.04 SUBMITTALS

A. Product Data. Submit six (6) copies of complete descriptive data for pumps and drivers, including, but not to be limited to the following: pump curves (high lite project specific performance points), NPSH requirements, horsepower requirements, project specific pump efficiency at all service points, materials of construction for pump components, solids handling capability and complete description of driver including horsepower, electrical characteristics, bearing life ratings, motor jacket insulation and insulation ratings.

B. Shop Drawings. Submit in accordance with Section 01300.

C. Manufacturer's Report. The manufacturer shall review the systems design in all matters relative to the proper operation of the equipment, including piping, valves, electrical service, automatic controls, alarms, locations, and related items. With the shop drawings, the manufacturer must submit a letter to the Owner’s Representative stating that the design is satisfactory to the manufacturer and that the equipment will operate satisfactorily under the project design conditions.

Upon completion of installation and in addition to the operational letter, a service engineer employed by the manufacturer will provide the Owner with a written report of start-up set points and calibrations. Final settings will be reviewed.

1.05 NOISE AND VIBRATION

Select equipment to operate with minimum of noise and vibration. If, in the opinion of the Owner's Representative, objectionable noise or vibration is produced or transmitted to or through building structure by equipment, piping ducts, or other parts of work, rectify such conditions without change in the contract sum.

PART 2 P R O D U C T S

2.01 SUBMERSIBLE PUMPS

A. Manufacturer. As indicated provide non-clog pumps as manufactured by Flygt, ABS, or approved equal. Each pump shall be furnished with a sufficient length of 13-2-1 hypalon jacketed type SPC cable to extend from the pump to the junction box or control panel outside of the pump containment structure. Each pump used in a submersible application shall be supplied with 316 stainless steel chain of adequate strength, and length, to permit lifting and lowering the pump without wet well entry.

B. Capacity and Efficiency

1. Head losses through the pump are not included in the total pumping head and suction head. Use pumping head and other terms as defined in the Standards of the Hydraulic Institute (ANSI/HI) as currently amended.

2. Supply pumps having peak design operating point within twenty Percent (20%) of peak efficiency. Pumps with curves constantly rising toward shut-off are preferred. Standard Maximum and minimum impellers are not to be used for initial conditions, except in special cases, and then only with approval of the Owner's Representative.

C. Pump Characteristics. The pumps shall meet all of the design and performance requirements as outlined on the table "Pump Characteristics" on the drawings.

D. Pump Design. The pump(s) shall be capable of handling raw unscreened sewage. The pump discharge piping shall include either a connection elbow permanently installed in the wet well along with the discharge piping or a threaded pipe connection on grinder units, 1.5 Hp and smaller. If a permanent elbow is used in a submersible application, the pump(s) shall be automatically connected to the discharge connection elbow when lowered in place, and shall be easily removed for inspection or service. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. Using either type of connection system, there shall be no need for personnel to enter the lift station wet well.

A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two stainless steel

guide bars or rails. When using a permanent elbow the pump shall be laterally supported by the guide bars (rails) and pressed tightly against the discharge connection elbow, with metal-to-metal contact. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal to metal contact between machined surfaces, resulting in controlled compression of nitrile rubber O-rings without the requirement of a specific torque limit to affect this. No secondary sealing compounds, rectangular gaskets, elliptical "O"-rings, grease or other devices shall be used. No portion of the pump shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 60 feet. Submersible grinder pumps (where specified) may have the pump casing resting on the floor via mounting legs and may use an O-ring sealing arrangement.

Alternatively, when the pump is used in a dry pit (non-submersible) application a permanent bolt down mounting base is to be supplied by the manufacturer. This mounting base is to be close-coupled to the pump suction connection and be constructed of either gray cast or ductile iron with a standard flange coupling pattern on both connection ends.

E. Pump Construction. Major pump components shall be of gray cast iron, Class 30, with smooth surfaces devoid of blow holes and other irregularities. Where watertight sealing is required, O-rings made of nitrile rubber shall be used. All exposed nuts and bolts shall be of stainless steel 316. All surfaces coming into contact with sewage, other than stainless steel, shall be protected by an approved sewage resistant coating. Pump exterior shall be sprayed with zinc primer and a high solids epoxy finish.

F. Cable Entry. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

G. Pump Motors

a. Pump Motor 10 horsepower and below. Cooling characteristics suitable to permit continuous operation in totally submerged, partially submerged, or non-submerged conditions without overheating. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type

design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of no less than 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.

The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of

continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

Securely affix in a conspicuous place on each pump and motor a standard stainless steel nameplate showing the serial number and name of the manufacturer. Also, show the capacity in gallons per minute at rated rpm and head in feet, impeller diameter, horsepower, speed and electric current characteristics. Nameplates with distributing agents only are not acceptable.

b. Pump Motor above 10 horsepower and below 100 horsepower. Cooling characteristics suitable to permit continuous operation in totally submerged, partially submerged, or non-submerged conditions without overheating. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.

The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single ball type bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L_{10} bearing life shall be 50,000 hours at any usable portion of the pump curve

The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C. ambient and shall have a NEMA Class B maximum operating temperature rise of 80° C. A motor performance chart shall be provided exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

Securely affix in a conspicuous place on each pump and motor a standard stainless steel nameplate showing the serial number and name of the manufacturer. Also, show the capacity in gallons per minute at rated rpm and head in feet, impeller diameter, horsepower, speed and electric current characteristics. Nameplates with distributing agents only are not acceptable.

H. Pump Shaft and Seals. The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings

shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves will not be acceptable.

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load. Seal lubricant shall be FDA Approved, nontoxic.

I. Impellers. Non-clog: The impellers shall be of gray cast iron, Class 35B, dynamically balanced, semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on the volute suction which shall keep them clear of debris, maintaining an unobstructed leading edge. The impeller(s) vanes shall have screw-shaped leading edges that are hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in waste water. The screw shape of the impeller inlet shall provide an inducing effect for the handling of sludge and rag-laden wastewater. Impellers shall be locked to the shaft and held by an impeller bolt.

The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable volute insert ring containing spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide the relief path and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The internal volute bottom shall provide

effective sealing between the multi-vane semi-open impeller and the volute. The insert ring shall be cast of (ASTM A-48 Class 35B cast iron or ASTM A 532 (Alloy lll A), 25% chrome cast iron)

A wear ring system shall be installed to provide efficient sealing between the volute and impeller. The wear ring shall consist of a stationary ring made of nitrile rubber molded with a steel ring insert which is drive fitted to the volute inlet and a rotating stainless steel ANSI 304 ring which is drive-fitted to the impeller eye.

J. Electrical Controls. Are to be provided as part of the process control with all connections, wiring and circuitry. See specification sections specific to electrical and controls.

K. Liquid Level Sensors. Furnish and install the liquid level sensing system as indicated on the drawings or specified in process control:

L. Access Hatch. Were indicated on the plans provide an aluminum access hatch complete with frame, hinged access doors with 316 stainless steel safety latch lockable hasp of size or dimensions shown on the plans and as required to install or remove submersible pump. The access hatch assembly shall include stainless steel springs for easy opening. This access hatch is to have 316 stainless steel tamper resistant nuts, bolts and stainless steel anchors affixed to the frame for embedment in concrete top covers.

Each hatch shall include an internal fall-through prevention aluminum safety grate, OSHA orange finish, with a minimum design capacity of 300 p.s.f. All mounting hardware shall be 316 stainless steel. The safety grate shall be independent of the access hatch, the safety grate shall be hinged to swing up and out of the way, leaving a clear access area as required to install or remove the submersible pump. The safety grate shall be removable for maintenance purposes.

2.02 PROCESS CONTROL

Provide a control panel complete with all mounting hardware, wiring, conduit, and components as shown on the drawings and/or indicated below. Related component and electrical specifications are found in Division 16 and/or indicated below.

A. Control Panel: Provide a NEMA 4x stainless steel free standing enclosure with a minimum 4 inch mounting legs on panel or as indicated on the drawings. The panel shall be affixed to corrosion resistant vertical mounting supports, and shall have a minimum 36 inch mounting height. All Motor Control Panels shall be made with external transformers for lighting and appurtenances.

B. Controls: Provide all required relays, circuit breakers, motor starters, phase and surge protection, alarm horn and light for a complete and operating system.

C. Liquid Level Controls: See plans.

D. Transformers shall be mounted independently in NEMA 4x stainless steel enclosure.

PART 3 E X E C U T I O N

3.01 SERVICE

A. A factory representative, as an advisor, shall be provided during the initial installation work; for the inspection and checkout of the erected equipment; and during instruction for initial operation. These services are to be for two (2) periods not exceeding five (5) days each.

B. Furnish the Owner with a written report from a service engineer employed by the manufacturer denoting start-points and calibrations. Obtain Owner's Representative's approval of final setting.

C. Arrange for manufacturer to have service personnel on 24-hour call.

3.02 WARRANTY

The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of two (2) year from the date of final project acceptance, under normal use, operation and service. The warranty shall be in printed form and apply to all similar units. (Contractor's responsibility shall end after the one year warranty period they are required to provide).

Each manufacturer shall review the systems design in all matters relative to the proper operation of their equipment, including piping, electrical, automatic controls, locations, and related items. With their shop drawings, the manufacturer must submit a letter to the Owner's Representative stating that the design is satisfactory to the manufacturer and that the equipment will operate satisfactorily under the design conditions. Further, the manufacturer must review the final installation at site and write a second letter stating that the installation is satisfactory to the manufacturer and that the equipment will operate satisfactorily under the installed conditions.

3.03 PUMP TEST

The pump manufacturer shall perform the following inspections and tests on each pump before shipment form factory.

A. Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.

B. A motor and cable insulation test for moisture content or insulation defects shall be made.

C. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

D. The pump shall be run for 30 minutes, submerged a minimum of six (6) feet under water.

E. After operational test submerged, the motor and cable insulation test is to be performed again.

F. A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment.

G. The pump cable end will then be fitted with a shrink fit rubber boot to protect it from moisture or water seepage prior to electrical installation.

END OF SECTION

SECTION 15033

HYDRAULIC SUBMERSIBLE PUMP WITH AUTOMATICALLY CONTROLLED DIESEL HYDRAULIC POWER UNIT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Requirements for providing permanently installed hydraulically operated diesel powered submersible pump with automatically starting diesel power unit. Submersible pump shall be rail mounted on typical "FLYGT" pipe rail system and mate to "FLYGT" type floor mounted base elbow similar to the electrical powered submersible pumps which will be a part of the lift station as well.

B. Operation of pump shall be both in rotation with controls for electric submersible pumps and capable of automatic operation independently after power failure.

C. Diesel Powered Hydraulic Unit shall be base skid mounted for either ground installation or mounting on a raised platform. Unit shall be fully enclosed in sound attenuated corrosion resistant housing, with stainless steel base tank.

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.

1.03 SUBMITTALS

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

B. Submit manufacturer's product data for proposed pumps for approval as specified below.

1.04 GENERAL

A. The specifications herein state the minimum requirements of the City of Galveston. All bids must be regular in every respect. Unauthorized conditions, limitations, or provisions shall be cause for rejection. The Owner may consider as "irregular" or "non-responsive", any bid not prepared and submitted in accordance with the bid documents and specification, or any bid lacking sufficient technical literature to enable the Owner to make a reasonable determination of compliance to the specification. It shall be the

bidder's responsibility to carefully examine each item of the specification. Failure to offer a completed bid or failure to respond to each section of the technical specification will cause the proposal to be rejected, without review, as "non-responsive". All variances, exceptions, and/or deviations shall be fully described in the appropriate section. Improperly documented response to the requirements of these specifications will be cause for rejection.

B. Bids will be accepted for consideration on any make and model that is equal to the specified Godwin "Heidra" Hydraulic Submersible Pumpset, hydraulic submersible pump and hydraulic power unit. Contractor shall submit in writing that equipment proposed will meet all requirements to establish equivalence, with manufacturer's explanation of each deviation or substitution.

C. Units described shall be new, unused, and of the current year's production. The style of pump being bid must be in production for a minimum of five (5) years (include users list). Unit shall be of the latest design and in current production completely serviced, ready for work and shall include all standard and optional equipment as specified herein. All bidders must have demonstrated the unit they are bidding, prior to bid date.

D. Suppliers must have a fully stocked parts and service facility within 100 miles of the City of Galveston. The Owner shall have the right to inspect the office and shall be the sole judge of its adequacy to fulfill this requirement.

E. Suppliers, on request of the Owner, must be prepared to review their specifications with the City of Galveston and must, if requested, also be prepared to provide a unit for the convenience of the Owner. These services, if needed, are considered as part of the bidder's proposal and will be provided without cost or obligation to the Owner.

PART 2 P R O D U C T S

2.01 SYSTEM DESCRIPTION

A. The portable hydraulic submersible pump specified in this section will be used to pump raw sewage.

B. The pump and accessories shall be supplied by the pump manufacturer.

C. The hydraulic submersible pump shall be powered by a gear type hydraulic motor that is capable of being powered by any open center hydraulic oil circuit.

D. The diesel engine hydraulic power unit shall be capable of powering comparably sized hydraulic motors on a submersible pump on a continuous operation.

E. The diesel engine driven hydraulic power unit shall be mounted on skid with integral UL listed fuel tank and sound attenuated enclosure.

F. Equipment acceptance shall be contingent upon its ability to run in a completely dry condition for periods up to 24 continuous hours at full speed. A demonstration may be required by the Owner's Representative.

G. The pump offered shall be a manufacturer's standard production model. It shall have been in continuous use by municipal and industrial owners for a minimum of five (5) years. A list of five user contacts including contact names and telephone numbers shall be provided with the bid submittal. Failure to supply a verifiable users list will be cause for rejection of the bid.

H. The pump shall be equipped to slide mount for installation using a "FLYGT" type pipe rail system. The pump shall be fitted with adapter and mating flange to seat on a "FLYGT" type base elbow. Pump shall be removable, for inspection, from the wet well without disconnecting the hydraulic hose from the submersible pump.

2.01 DESIGN REQUIREMENTS

A. SUBMERSIBLE PUMP

OPERATING SPEED (MAXIMUM)	1,600 RPM
MINIMUM SOLIDS HANDLING SIZE	3 INCHES
IMPELLER DIAMETER	00 INCHES
INLET SIZE	00 INCHES
DISCHARGE SIZE	00 INCHES
MAXIMUM DUTY POINT	000 GPM AT 00' TDH

B. HYDRAULIC POWER UNIT

OPERATING SPEED (MAXIMUM)	2,400 RPM
MAXIMUM OIL FLOW	10 GPM
MAXIMUM HYDRAULIC PRESSURE	3,500 PSI
OIL RESEVOIR SIZE (MINIMUM)	40 GALLONS

2.02 ACCEPTABLE MANUFACTURERS

A. EQUIPMENT

1. CASTING / VOLUTE: Pump casting shall be cast iron. It shall be constructed so that the suction flow path is in axial alignment with the impeller eye. Pump casing shall be fitted with guide rail adapter for installation in wet well.

2. IMPELLERS: The pump impeller shall be of open non-clog type with pump out vanes on the back shroud. The impeller shall be Three-bladed of hardened cast chromium steel construction.

3. WEARPLATES: The pump shall have top and bottom wearplates. The wear

plates shall be fully adjustable and replaceable with a minimum hardness of 220 Brinnell, fabricated of cast iron.

4. BEARINGS AND SHAFTS: Pump shall be fitted with a heavy duty cast iron bearing bracket which contains the shaft and heavy duty ball or tapered roller bearings of adequate size to withstand imposed loads. Minimum I.S.O. L10 bearing life to be 100,000 hours. Impeller shafts shall be of 1½% chromium alloy.

5. SEALS: The pump seal will be a double mechanical seal arrangement. The lower mechanical seal shall be a mechanical self-adjusting type with silicon carbide faces. The upper mechanical seal shall also be a mechanical self-adjusting type with carbon ceramic faces. The mechanical seal shall be cooled and lubricated in an oil bath reservoir, requiring no maintenance or adjustment. Pump shall be capable of running dry, with no damage, for periods up to 24 hours. All metal parts shall be of stainless steel. Elastomers shall be Viton.

6. PUMPEND HYDRAULIC MOTOR: The pumpend hydraulic gear type motor shall be capable of receiving 33-GPM at 3,500-psi at 2100-RPM. It shall be designed to be able to stop immediately on braking of hydraulic flow due to automatic start & stop of hydraulic power unit without damage. This shall be accomplished through the use of an internal or external hydraulic assembly.

7. PUMP DISCHARGE CONNECTION: Shall be cast iron XXXX inch flange. Adapted to base elbow for floor mounting with pipe rails.

8. PUMP GASKETS: Shall be compressed fiber and/or Teflon

9. PUMP O-RINGS: Shall be Viton.

10. POWER UNIT: Hydraulic power unit shall have an open center hydraulic circuit capable of providing up to 10 GPM at 3,500 psi at 2,400 RPM engine speed on a continuous basis. The hydraulic circuit shall include a gear type hydraulic pump mounted to the engine flywheel, a minimum 40 gallon hydraulic reservoir with suction strainer, low oil and high temperature shutdowns, sight level gauge, in tank return line filter rated for 20 microns, pressure gauge, on/off detent control valve with integral adjustable relief valve, hydraulic oil cooler with thermo bypass valve, and quick disconnect fittings.

11. DRIVE UNIT: Diesel shall be water-cooled engine. Engine shall drive pump by use of direct connected intermediate drive plate. Starter shall be 12 volt electric. Safety shut down switches for low oil pressure and high temperature shall be

provided. Battery shall have 180 Amp hour rating, 100-minute reserve capacity with 500 cold cranking amp capacity. Unit shall include a tachometer and an hourmeter. Alternator shall be sized to 60 amp. Unit shall be a Yanmar or equal, for continues use at 2,100 RPM. A certified continuous duty engine curve shall be supplied to the owner/Owner's Representative.

12. GOVERNOR: Governor shall be mechanical type. Engine speed shall be adjustable to operate the hydraulic power unit between maximum and minimum design operation speeds.

13. FUEL TANK: Integral fuel tank capacity shall be sufficient to provide at least 168 hours (7days) of operating time at full load. The engine shall be capable of operating satisfactorily on a commercial grade of distilled No. 2 fuel oil. Fuel tank base shall be UL design as specified in 2.02, B. SKID BASE, and be of stainless steel construction.

14. EXHAUST: Exhaust system shall include a hospital grade muffler housed in a separate chamber within the enclosure. All exhaust piping and manifolds shall be encased in fitted acoustic blankets. They shall be constructed of high-density fiberglass material with waterproof jacketing.

15. HYDRAULIC HOSES: The submersible pump and hydraulic power unit shall come complete with two (2) 1" x 50' and one (1) ½" x 50' case drain hydraulic hoses with quick disconnect couplings. Suitable for use in sewage, submerged use.

16. SOUND ATTENUATED ENCLOSURE: The engine and pump shall be completely enclosed with fourteen-gauge sheet metal panels backed with one inch and two-inch layers of polydamp acoustical sound-deadening material. The acoustical enclosure shall reduce pump and engine noise to sixty-eight dBA or less at a distance of thirty feet. The enclosure shall be removable for easy access to the engine / pump for maintenance and repair. The enclosure doors shall all be equipped with latches that are keyed alike. For maintenance and service needs, the enclosure sides shall have hinged doors for quick access to the engine oil fill, fuel fill port, oil dipstick, and filters.

B. SKID BASE

1. The pump base tank shall be a UL-142 approved double wall design constructed in accordance with Flammable and Combustible Liquids Code, NFPA 30; The Standard for Installation and use of Stationary Combustible Engine and Gas Turbines, NFPA 37; and The Standard for Emergency and Standby Power Systems, NFPA 110.

2. The tank design shall be a Closed Top Dike Pump Base Tank. It shall be of double wall construction having a primary tank to contain the diesel fuel, held within another tank or dike, which is intended to collect and contain any accidental leakage from the primary fuel tank. The completed base tank assembly is to incorporate pump mounting locations and must be able to support four times the rated load.

3. The primary tank shall be designed to withstand normal and emergency internal pressures and external loads. It shall be capable of withstanding internal air pressures of 3 to 5 psig without showing signs of excessive or permanent distortion and 25 psig hydrostatic pressure without evidence of rupture or leakage.

4. The primary and secondary tanks or dike shall have venting provisions to prevent the development of vacuum or pressure capable of distorting them as a result of the atmospheric temperature changes or while emptying or filling. The vent shall also permit the relief of internal pressures caused by exposure to fires. The vent size shall be determined by using the calculated wetted surface area in square feet (the top is excluded) in conjunction with venting capacity table 10.1of UL-142. The tank's vent shall also be equipped with a coupling device and shall be located to facilitate connection to a vent piping system. The dike's vent may be an opening for venting directly to the atmosphere and protection from the entrance of natural elements or debris shall be provided.

5. The primary tank is to be constructed of 7 gauge hot rolled stainless steel. Internal baffles or reinforcement plates shall be located on a maximum of 24 inch centers in tanks up to 60 inch width and on a maximum of 19.5 inch centers in tanks over 60 inch width. At least one baffle shall separate the fuel suction pipe from the fuel return line

6. The outer tank is to be constructed in a manner to be able to support four times the wet load of the pump and housing. The entire load is to be carried by the outer tank so no load or vibration stress is placed on the primary tank. If the pump base tank is wider than the pump set to be supported, structural rails are to be incorporated to span the width of the base tank so that the load is transferred to the side rails of the tank. Vertical reinforcements shall be welded to the outer sides of the secondary tank or dike at a maximum of 45 inch centers on tanks up to 30 inches high and on 24 inch centers on tanks greater than 30 inches high. At least one vertical reinforcement shall be positioned adjacent to each mounting hole location.

7. Both primary and secondary tanks shall be fitted with the proper welded pipe

fittings to accommodate the requirements for the fill port and normal and emergency venting.

8. The completed assembly is to be cleaned with a heated pressure wash followed by a chromium free post treatment to ensure proper paint adhesion. The tank assembly is to be painted with an epoxy ester primer and high quality polyurethane enamel with total paint thickness of 3.5 mils. The painted tank assembly is to be baked at 180 degrees for 30 minutes to provide a hard durable finish.

9. Manufacturing and testing of this system shall be performed within the scope of Underwriters Laboratories, Inc. "Standard for Safety UL 142." A UL label shall be permanently attached to the tank system showing the following information:
   - The registered UL mark and the name: Underwriters Laboratories, Inc.
   - A control number and the word "listed"
   - The product's name as identified by Underwriters Laboratories Inc.
   - The serial number assigned by Underwriters Laboratories, Inc.
   - Other manufacturer's information may also be included.

10. HYDRAULIC HOSES: The submersible pump and hydraulic power unit shall come complete with two (2) 1" x 50' and one (1) ½" x 50' case drain hydraulic hoses with quick disconnect couplings. 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.

11. FACTORY PAINTING: Pump, engine, base, and trailer shall be shop primed and finish painted at the place of manufacturer. Materials and thickness for priming shall be in accordance with manufacturer's standards.

C. AUTOMATIC STARTING CONTROL SYSTEM

1. The engine shall be equipped with a factory installed "PrimeGuard" microprocessor-based controller as supplied by Godwin Pumps of America, Inc. or equal and designed to start/stop the engine at a signal supplied by high and low level floats or a 4-20 mA transducer.

D. ENGINE/PUMP CONTROL SYSTEM

1. The engine shall be started, stopped, and controlled by a "PrimeGuard" high performance state of the art digital controller as supplied by Godwin Pumps of America, Inc. or equal. The controller shall be weather proof enclosed, and contain an external weatherproof 12-position keypad accessible without the need

to remove or open any protective cover or enclosure. It shall be designed to start/stop the engine at a signal supplied by high and low level floats or a 4-20 mA transducer. The "PrimeGuard" controller shall provide the following functions without modification, factory recalibration, or change of chips or boards, by simply accessing the keypad

2. The keypad shall be a capacitive touch sensing system. No mechanical switches will be acceptable. The keypad shall operate in extreme temperatures, with gloves, through ice, snow, mud, grease, etc. and maintain complete weather-tight sealing of the "PrimeGuard" controller.

3. In automatic mode, the unit shall conserve energy and go to "sleep".

4. The "PrimeGuard" controller shall function interchangeably from float switches, pressure switch, or transducer, as well as manual start/stop by selection at the keypad. No other equipment or hardware changes are required.

5. The "PrimeGuard" controller shall function interchangeably from float switches, pressure switch, or transducer, as well as manual start/stop by selection at the keypad. No other equipment or hardware changes are required.

6. The "PrimeGuard" controller shall be capable of varying the engine speed to maintain a constant level in a process without a change to the controller other than via the keypad.

7. The start function can be programmed to provide three separate functions each day for seven days (i.e. a start, warm up, exercise cycle on two separate days at different times and for a varying length of time all via the keypad).

8. Manual-Automatic Button:
   a. In Manual Mode, manual "Start" button starts engine and runs until "Stop" button is depressed or an emergency shutdown occurs.
   b. In Automatic Mode, start/stop sequencing is initiated by either two normally-open narrow angler float switches, pressure switch, transducer, or a signal from a digital input.

9. The controller shall integrate the engine safety shut-off for low and high oil temperature, and provide over-speed protection.

10. The controller shall include standard, field-adjustable parameters for engine cycle crank timer, shutdown time delay, warm-up time delay, and cool-down time delay.

11. The "PrimeGuard" controller shall have only one circuit board with eight built-in relays. Each relay can be named to provide any function, all via the keyboard without changing relays, chips, printed circuits, or any hardware or software.

12. Standard components, at a minimum, shall consist of (24) digital inputs, (7) analog inputs, (1) magnetic pick-up input, (8) 20-amp form "C" relays, (1) RS232 port, (1) RS485 port, (1) RS232/RS485 port, (1) J1939 port, and (1) 64X128 pixel full graphic LCD display with backlight.

13. The industrially-hardened "PrimeGuard" Controller shall withstand Vibration of 3 g, 3 axis, frequency swept 10-1000 Hz, in an operating temperature Range of 4° to 176°F (-20° to 80°C) and an operating humidity range of 0-95% Non-Condensing.

14. FLOATS: The unit shall be supplied with one (1) float assembly including two (2) N/O floats which shall integrate with the engine control panel via a single multi-pin plug.

15. FULLY AUTOMATIC TRICKLE CHARGER: The power unit shall include a fully automatic trickle charger powered by 115-VAC, 6-amps, job-site power.

PART 3 E X E C U T I O N

3.01 MANUFACTURERS SERVICES

A. The manufacturer shall furnish the services of a competent factory representative to do the following:

1. Inspect the system prior to delivery, supervise the start up and testing of the system, and certify the system has been properly furnished and is ready for operation.

2. Instruct the owner's operating personnel in the proper operation and maintenance of the system for a period of not less than one half day.

3.02 TOOLS AND SPARE PARTS

A. The manufacturer shall furnish the following with the Pump System:

1. A recommended list of spare parts.

3.03 WARRANTY

A. A copy of the engine manufacturer's parts and labor warranty.

1. A One year Parts and Labor Warranty issued by the manufacturer on the Pump System. This warranty must cover all pump parts, including the mechanical seal.

END OF SECTION

SECTION 15053

LIFT STATION PIPING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A Piping for lift station wet well and valve vault, as shown on the Drawings.

1.02 REFERENCES

A ANSI A21.10, AWWA C110 - Ductile Iron Fittings 3 in. through 48 in., for water and other liquid.

B ANSI B36 - Stainless Steel Pipe.

C AWWA C151 - Ductile Iron Pipe, centrifugally cast in metal molds or sand-lined molds for water or other liquids.

D ANSI A21.15, AWWA C115 - Flanged Ductile Iron Pipe with Threaded Flanges.

E ANSI B16.1 Ductile Iron Pipe Flanges and Flanged Fittings.

F AWWA C111, ANSI A21.11 - Rubber Gasket Joints.

G AWWA C600 - Hydrostatic Testing.

H AWWA C606 - Grooved and Shouldered Joints.

I ANSI B1.1 Screw Threads.

J ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

K ASTM A194 - Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

1.03 SUBMITTALS

A Submit detailed drawings on pipe, joints, gaskets, fittings, flange coupling adapters, and appurtenances.

B Submit shop drawings indicating dimensions, layout of piping, elevations, intersections, connections, support system, etc.

C Submit manufacturer's Certification of Compliance with ANSI, AWWA and other Standards listed herein.

D Submit description of proposed testing methods, procedures and apparatus and test reports for each system.

1.04 QUALITY ASSURANCE

A Manufacturer's Qualifications

1. Piping and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.
2. Insofar as possible all piping and appurtenances of the same specific type shall be the product of one (1) manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

A Have products delivered, stored and protected under provisions of Section 01600 Material and Equipment.

PART 2 P R O D U C T S

1.01 MATERIALS

A Ductile Iron Pipe: AWWA C151, Class 53 minimum.

1. Fittings: AWWA C110

2. Joints: Smooth faced ductile iron flanges, AWWA C115 drilled for NASI BIG.1, Class 125 dimension, with threaded flanges and 1/8" thick rubber gaskets.

3. Bolts, studs and nuts: ASTM A-316 stainless steel.

4. Flanges: Same material as pipe and screwed onto the pipe in accordance with ANSI B16.1. Use screwed-on flanges attached to the pipe by the pipe manufacturer or pipe manufacturer's authorized fabricator.

5. After flange attachment, have flange and pipe re-faced so that the end of the pipe is even with the face of the flange and both are perpendicular to the axis of the pipe.

6. All flanged joints shall be hydrostatically tested after fabrication to a pressure rating of 300 psi minimum. All flanged joints shall be marked (Tested at 300 psi) and notarized certification papers supplied to the purchaser.

7. Align bolt holes on both flanges at the end of each piece of pipe.

8. Where cap screws or stud bolts are required, incorporate tapped holes for such cap screws or stud bolts in the flanges.

9. Interior Lining: Coat pipe in accordance with Section 02629 Polyurethane Coatings on Steel or Ductile Iron Pipe. See Table following.

10. Exterior Coating: Coat pipe in accordance with Section 02629 Polyurethane Coatings on Steel or Ductile Iron Pipe. See Table following.

All piping in wet well to be sand blasted and painted according to this Paint Schedule. Color: Forrest Green	Submerged Metals
	Surface Preparation: SSPC-SP-5 White Metal Blast 1st Coat: Amercoat 395 Epoxy*; 5-6 mils. 2nd Coat: Amercoat 395 Epoxy*; 5-6 mils. 3rd Coat: Amercoat 395 Epoxy*; 5-6 mils
All piping in valve pit (gate/plug, check valves, etc.) to be painted according to the Paint Schedule. Color: Brilliant Blue	Non Submerged Metals
	Surface Preparation: SSPC-SP-10 Near White Blast 1st Coat: Dimetcote 21-5 Inorganic Zinc; 3 mils.* 2nd Coat: Amercoat 385 Epoxy; 4 mils.* 3rd Coat: Amershield Urethane; 3 mils.* Min. DFT 10 mils
This also applies to concrete walls in valve pit to be blasted and painted according to paint schedule. Color: Light Buff (Ivory)	Interior Concrete Wet Well Liner
	Surface Preparation: SSPC-SP- 7 Sweep Blast* RAVEN 405 spray applied. 125 mils Min. DFT 100 mils

* or approved equal

11. Performance: Use pipes and fittings designed for an internal working pressure range of -10 to +150 psi.

B Wall Pipes: Ductile iron flanged with water stop collar.
1. Ductile iron water stop collar to be welded on the wall pipe prior to installation of the interior lining.
2. Interior Lining: As specified for pipe in paragraph 2.01A.9.
3. Bolts, studs and nuts: Type 316 stainless steel.

C Flanged Coupling Adapter:
1. Type: Ductile iron; Romac Industries, Style FCA501, Dresser Style 128, or approved equal.
2. Interior Lining: As specified for pipe in paragraph 2.01A.9, or heat-fused epoxy coating complying with AWWA C213.
3. Bolts, studs and nuts: Type 316 stainless steel.

D Grooved Couplings: Grooved couplings conforming to AWWA C606 may be used for exposed piping outside of the wet well.

1. Manufacturers: Gustin-Bacon, Victualic Style 31 (flexible or rigid).
2. Bolts and Nuts: Type 316 Stainless Steel.
3. Gaskets: Flush seal type, compatible with the fluid, according to the manufacturer's recommendations.
4. Pipe Wall Thickness: Wall thickness of grooved piping shall conform to the coupling manufacturer's recommendations to suit the highest expected pressure.
5. Equipment Connections: Equipment connections shall be rigid-type grooved couplings unless thrust restraint is provided by other means.
6. Require the manufacturer to verify correct choice and installation of couplings, gaskets, and workmanship to assure correct installation.

E Air Release Piping: Schedule 40, ANSI B36 stainless steel with ANSI B1.20.1 threaded joints.

E X E C U T I O N

1.02 INSTALLATION

A Check dimensions shown on the Drawings prior to installation of Work. Notify the Owner’s Representative promptly of any conflicts or errors.

B Run pipe lines straight and true in alignment, grade and location as shown on the Drawings.

C Install piping through walls and floors as shown on the Drawings.

1.03 PIPE IDENTIFICATION LABELS

A Label piping as follows:

1. Identify all piping with plastic sleeve snap-on markers equivalent to Seton Name Plate "Setmark" or approved equal with 3/4-inch letters on pipe sizes to 4-inch and 2-inch letters on pipe sizes 5-inches and larger, or approved equal.
2. Locate at each valve, each branch take-off, and at each side of floor or wall through which pipe passes.
3. Not more than one label is required every 12 feet if adjacent label is visible.
4. Place labels on all lines.

1.04 TESTING

A Flush pipes clean. Tighten connections to stop any visible leaks.

B Test piping in accordance with Section 4-Hydrostatic Testing, AWWA C600.

C Test piping to a pressure of 150 percent of the maximum possible discharge pressure of the pumps.

END OF SECTION

SECTION 15101

VALVES AND ACCESSORIES FOR LIFT STATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A Valves and accessories for exposed, submerged and other types of piping for lift station.

1.02 REFERENCES

A. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. AWWA C509 - Resilient Seated Gate Valves.

C. AWWA C508 - Check Valves.

D. AWWA C500 - Gate Valves.

E. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

F. ASTM A395 - Ductile Iron Castings.

G. ASTM A48 - Gray Iron Castings.

H. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.

I. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Valves and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Insofar as possible all valves of the same specific type shall be the product of one manufacturer.

1.04 SUBMITTALS

A. Submit shop drawings and product data in conformance with all provisions and sections of these specifications.

B. Shop Drawings

1. Submit for review detailed drawings, data and descriptive literature on valves and appurtenances, including:

a. Dimensions.

b. Size.

c. Materials of construction.

d. Weight.

e. Protective coating.

f. Actuator weight, where applicable.

g. Calculations for actuator torque, where applicable.

h. Wiring diagram, where applicable.

2. Submit manufacturer's valve sizing calculations for verification of sizing for air release valves, air and vacuum valves, and surge relief valves.

C. Manufacturer's Certifications

1. Submit manufacturer's certificates of compliance with ANSI, AWWA and other listed standards.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01300 - Submittals.

B. Submit a detailed operation and maintenance manual for valves and appurtenances provided under this Section.

1.06 DELIVERY, STORAGE AND HANDLING

A. Have products delivered, stored and protected under provisions of Section 01600 - Material and Equipment.

B. Store valves and appurtenances off the ground in enclosed shelter.

PART 2 P R O D U C T S

2.01 BASIC REQUIREMENTS

A. Mark and identify valves in conformance with standards, these Specifications or to the manufacturer's standard.

B. Bolts, studs and nuts to be Type 316 stainless steel.

C. End connections of valves shall be flanged and drilled to ANSI Class 125 unless otherwise specified.

D. For handwheel operators on valves 4 inches or larger where located more than 5 feet above the operating floor, provide chain and chainwheel or extension operators. Use chainwheels fabricated of malleable cast iron with chain guides. Provide stainless steel chains of a length to extend to within 5 feet of the operating floor.

2.02 CHECK VALVES

A. Swing check valves 4-inches through 14-inches having a system pressure 30 psi or less, shall be air cushioned with side mount lever and weight. The valve shaft shall extend through both sides of the body with minimum shaft diameters equal to APCO Series 6000. The cushion shall be totally enclosed, swivel mounted at the bottom, and equipped with a micrometer air control valve and air breather filters. Valves shall be similar to APCO Series 6000, or approved equal.

B. Swing check valves 10-inches through 14-inches having a system pressure greater than 30 psi shall be cushioned with side mount lever and weight. Valves shall be similar to APCO Series 6100, or approved equal.

C. Swing check valves 16-inches and larger regardless of system operating pressure shall be cushioned with side mount lever and weight. Valves shall be similar to APCO Series 6100, or approved equal.

D. Check valves of special design utilizing controlled closing of the disc, such as APCO Series 6000B (Bottom-Buffer) and Golden Anderson Fig. #25-DXH or approved equal shall be used when specifically indicated on the Drawings. These valves are special valves used to control the surge pressure in the force main upon multiple pump shutdown during a power failure. Other surge control check valves utilizing ball or cone valve and power cylinder operator may also be used as approved by the City Engineer.

E. All check valves shall have 300 series stainless steel hinge shafts, stainless steel body seats and stainless steel resilient seat retainer rings.

2.03 GATE VALVES

A. Gate valves 4 inches through 14 inches: Solid wedge type, with resilient nitrile rubber (Buna- N) tapered seat. Provide valves complying with AWWA C-509. Acceptable manufacturers include Mueller, M&H, AVK, or approved equal.

B. Gate valves 16 inches and larger: Solid wedge type with bronze to bronze seating surface. Provide valves complying with the AWWA C-500. Acceptable manufacturers include Mueller, M&H, AVK, or approved equal.

C. Supply gate valves rated as 200 psi water working pressure with 400 psi hydrostatic test for structural soundness for 2 inches through 12 inches and 150 psi water working pressure with 300 psi hydrostatic test for structural soundness for sizes 14 inches through 30 inches.

D. Stems: OS&Y rising type manganese bronze having a minimum tensile strength of 60,000 psi, a minimum yield strength of 20,000 psi for valve sizes through 24 inches, and a minimum tensile strength of 80,000 psi, a minimum yield strength of 32,000 psi for valve sizes 30 inches and larger. All valves must open counter-clockwise.

E. Valve Bodies: Cast iron conforming to ASTM A126 or ASTM A395. Fabricate internal trim parts of 300 series stainless steel.

2.04 ECCENTRIC PLUG VALVES

A. Eccentric plug valves shall open counter-clockwise and be the non-lubricated eccentric type with cast iron bodies, resilient-faced plugs or replaceable resilient seats in the bodies.

B. Operators: All valves for 4-inch and larger service shall have worm gear operators, nickel or stainless steel seats, and ANSI 125 psi flanged ends. Operators shall clearly indicate valve position. Operators on valves in submerged or buried service shall be lubricated and sealed to prevent entry of dirt and water into the operator.

C. Resilient facing shall be suitable for the intended service.

D. All shaft bearings shall be of stainless steel, furnished with permanently-lubricated bearing surfaces.

E. Valves up to and including 20 inches in size shall have an unobstructed port area of no less than 80 percent of the full pipe area, and not less than 70 percent for larger valves.

F. Eccentric plug valves shall be manufactured by Clow, De Zurik, Keystone, Val-Matic, or Victualic.

2.05 SEWAGE AIR RELEASE AND SEWAGE AIR AND VACUUM VALVES

A. Air Release and Air and Vacuum Valves: Provide when shown on Drawings.

B. Sewage Air Release Valve Design: See specifications Section 02642 Air Release and Vacuum Valves.

C. Sewage Air and Vacuum Valve Design: See specifications Section 02642 Air Release and Vacuum Valves.

D. Fit valve with blow off valves, quick disconnect couplings and minimum 6-feet of hose to permit back flushing after installation with dismantling valve..

E. Provide air and vacuum valves equal to A.R.I. Flow Control Accessories Ltd.

2.06 SURGE RELIEF VALVES

A. Surge Relief Valves: Provide when shown on Drawings.

B. Operation: Surge relief valves shall protect piping systems from surges by opening quickly at a set pressure and throttling the flow to maintain line pressure at no more than 5 to 10 percent above the pressure setting indicated. Provide relief pressure adjustment by changing the tension on a spring holding the valve disc on its seat.

C. Valve Closing Control: By oil dashpots. Oil shall be drawn into the dashpot from a reservoir when the valve opens and return through a flow control valve when the relief valve closes.

D. Valve Construction: Fabricate valve bodies of cast iron with 300 series stainless steel seat rings. Provide seats that are renewable and resilient. Fabricate hinge shafts of stainless steel and the oil system of bronze. Unless otherwise indicated make the pressure setting 5 percent above normal line pressure.

E. Provide surge relief valves that are 90-degree elbow body configuration. Acceptable manufacturers include APCO series 3000, A.R.I. Flow Control Accessories Ltd. 625-D, or approved equal.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install valves and specialties in accordance with manufacturer's written instructions to permit intended performance.

B. Support and anchor valves and gates in accordance with the Drawings.

C. Eccentric plug valves shall be installed according to the following:

1. Position the valves with the stem in the horizontal direction.

2. In horizontal pipelines, position the vales so that the plug swings upward when opening to permit flushing of solids.

3. Orient the vales to prevent the valve bodies from filling up with solids when closed; however, orient the valves such that the pressure differential forces the plug against the seat in cases where the pressure differential across a closed valve will exceed 25 psi.

3.02 PAINTING

A. Paint valves and specialties in accordance with applicable AWWA standards and with the Drawings.

3.03 TESTING

A. Test valves using a hydrostatic pressure test in accordance with AWWA C-600.

B. Test valves and specialties in place. Correct defects in valves, specialties or connections.

END OF SECTION

Section 15443

Field Code Changed

LIFT STATION MONITORING CONTROL SYSTEM

PART 1 G E N E R A L

1.0 General

1.1 Scope of Work

The contractor shall furnish, install, start up and place into service a factory built pump control system engineered to operate sewage pumps in a sewage lift station as described herein. The control system shall be designed utilizing the latest proven technology in control design for sewage lift stations. The control system shall be easy to maintain and user friendly to ensure easy system set up and minimize down time.

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The pump control system shall be capable of operating the involved pumps at their maximum horsepower ratings and the associated interconnecting controls in a constant speed across the line (ACL) mode in order to efficiently pump sewage to the next lift station without causing a sewage over-flow wherever possible regardless of system demands. The entire control system specified herein shall be built and warranted by the manufacturer of the specified controller. The control system shall be comprised of a standard off the shelf microprocessor. Programmable logic controllers with custom software shall not be acceptable. The controller shall have the following features and meet all the requirements described in section 3.1

2.0 Products

2.1.1 Codes

Electrical equipment, materials and workmanship shall comply with all applicable codes, safety and fire law regulations at the location of the work and shall conform to applicable codes and standards of the organizations listed below:

- National Electrical Manufacturers Association (NEMA)
- Underwriters Laboratories. (UL-508A or 698A for intrinsically safe)
- American National Standards Institute. (ANSI)
- National Electric Code. (NEC)

2.1.2 Component Standards

All control panels shall be as manufactured by Best Controls. All equipment and materials shall be new and shall bear the manufacturers name and trade name. In cases where the standard has been established for the particular material, the material shall be labeled as such. All equipment being furnished shall be the standard product of a manufacturer that regularly engages in the production of the said equipment. All equipment being supplied shall be the manufacturers latest approved

design. The specified equipment and material shall be suitably delivered and stored and shall be readily accessible for inspection.

2.2 Construction

2.2.1 Enclosure

The described equipment shall be housed in a Hoffman NEMA 4 X stainless steel enclosure fabricated from 14 gauge Type 304 stainless steel with a white polyester powder coat finish inside and out to reduce absorption of solar radiation so as to appreciatively reduce the internal temperature of the enclosure to extend the longevity of the internal components. The enclosure shall include a Type 316L stainless steel small POWERGLIDE® padlocking handle and internal 3-point latching combine ease of access with security.

The enclosure size shall be approximately 36 inches high, 30 to 36 inches wide and 12 inches deep. Pilot and indicator devices shall be mounted on the hinged inner door.

2.2.2 Hinged Inner Door

The hinged inner door shall be fabricated from painted marine alloy aluminum. It shall be held closed by at least (2) hand operated 1/4 turn fasteners.

2.2.3 Control Circuit Wiring

Control circuit wiring inside the panel shall be (16) gauge minimum, type MTW or THW, rated for 300 volts. All power wiring shall be rated for 600 volts. Conductors shall be color coded in the same colors throughout the entire panel. All control wiring shall be clearly identified by numerical or alphabetical wire markers. The wire markers shall be permanently affixed to the control wire terminations for ease of wire identification.

3.0 Equipment Description

3.1 Pump Controller

The Best Controls Model PC-3000 is a general purpose pump controller designed to control up to 3 pumps, in either pump up or pump down applications. It sequences pumps on and off in response to changes in level, pressure, or flow. The primary sensor input is a 4 to 20 Ma. current loop which can be connected to any sensor which has a 4-20 Ma output. output. When used to control level in a tank or well the input is usually connected to a pressure transducer, or ultrasonic transmitter. A loop power supply is provided in the PC-3000.

The PC-3000 shall be configurable for many applications using its front panel user interface. Wiring terminations shall include removable terminal blocks on the back cover. The controller shall have the following features:

- 32 character alpha-numeric liquid crystal display for level, status, and set point information.
- An alternation selection switch on front panel to turn alternation on and select the lead pump if alternation is off.
- Simple menu structure for easy display and modification of set points and setup configuration.
- Built in elapsed time meters for all pumps. They are nonvolatile and easily examined from the front panel.
- 4 to 20 mA main sensor input with loop power supply for easy connection to most transducers and transmitters.
- Adjustments are provided for both scale and offset.
- Inputs for pump seal leak sensors and pump over temperature sensors with display messages for out of specification conditions.
- Fully scaleable 4-20 mA output transmitter.
- Built in single float backup system for pump down applications.
- Three auxiliary inputs which can be pump disable or pump run confirmation inputs for a fail to start test.
- Built in horn relay with internal and input for external mute button.
- Relay outputs for both high and low level alarms with adjustable set points.
- Individually selectable on and off set points for up to three pumps.
- All inputs are filtered and transient protected.
- Built in software, no programming required.
- All inputs operate on low voltage and current.
- Input power is 115 V AC, internally fused and transient protected.
- All terminal strips unplug without removing the wires for easy field replacement.

3.2 OPERATION

3.2.1.1 PUMP DOWN OPERATION

Pump down operational controls shall be applied in these wastewater lift station applications. These control panels are specified so that they will serve to function for both a duplex and a triplex operation. A triplex controller shall be provided regardless of the number of pumps involved. Two electrically driven pumps will be interconnected for the duplex pump stations. Two electrically driven pumps and one diesel driven pump will be interconnected for the triplex pump stations. The controls shall include a duplex/triplex selector switch on the inner swing out door. When applied in the field for the triplex lift station this selector switch shall inhibit the diesel driven pump from operating when it is placed in the duplex position. This shall permit the diesel driven pump to be included in the normal triplex alternation scheme at times so that the diesel engine and related components are exercised. The diesel driven pump shall be independently started upon sensing of a high-high level condition in the wet well. This shall be accomplished through an independent float switch for this purpose. Whenever the diesel driven pump is operating the two electrically driven pumps shall be interlocked out to prevent their operation.

The level shall be continually monitored by the level transmitter which shall send a 4-20 mA signal to the controller which shall display the level on the first line of the display. If the level is below the low alarm set point then the low alarm light and relay are activated. If the horn is enabled then it too shall be activated. As the level rises above the low alarm set point the low alarm condition will be cleared. When the level rises above the lead pump on set point the lead pump will be called to run. Which pump is the lead pump is determined by the alternator. The current lead pump is displayed on the right side of the top line of the display. When the lead pump starts the liquid level should begin to fall as liquid is pumped out of the well. When the level falls to the lead pump off set point then the lead pump will be stopped and the alternator sequenced if it is on. If the level continues to rise it will reach the lag pump on set point and the lag pump will be called. If the level then falls to the lag pump off set point then the lag pump will be turned off. The lag pump will not be called if the total number of pumps set point is 1. If the lead and lag pump running do not cause the level to fall then the third pump will be called when the level reaches the lag2 on set point and if three pumps are selected for the maximum number of pumps. If the level continues to rise then it will reach the high alarm set point and set a high alarm condition. The high alarm light and relay will be activated. If the horn is enabled then it too will be activated until the alarm condition clears or until the mute button is depressed.

3.2.1.2 FLOAT BACKUP

Two Float Backup System

A float backup system that utilizes a common off float and a signal on float shall be provided that operates independent of the pump controller. During normal operation FS1 would be set slightly below the normal off level set within the pump controller and FS2 higher than the HWA level set within the pump controller. FS1 would be closed during normal operation and in the event that the primary control system fails to bring on pumps and the level in the wet well raises above the normal HWA level FS2 will close, the "Float Backup" light on the on the inner will illuminate, the HWA light will come on, the auto dialer will call out, a pump will come on, the lag pump on timer will be energized. If FS2 does not open prior to the lag pump on time delay timing out a second pump will be called for. The float back up will lock out the pump controller from controlling pumps until the float backup circuit is reset on the front of the inner door.

3.2.1.3 PUMP SEQUENCE TIMERS

In both pump up and pump down modes there are two timers which prevent more than one pump from turning on or off at the same time. These timers prevent excess power loads when pumps are turning on and some hydraulic problems (water hammer) when pumps are being turned off.

3.2.1.4 TIME AT SET POINT

The PC-3000 shall be equipped with a feature which prevents any pumps from being turned on or off until a set point condition has been satisfied for a minimum time. This minimum time is the TIME AT SP set point in the setup menu and can be set from 0 to 31 seconds. As an example, assume this set point is set for 8 seconds, and we have a pump down system (lift station). Then, the water level in the tank must exceed the lead on set point continuously for 8 second before the lead pump will be called. There is not much need for this in most lift stations as the level changes

slowly but this feature can be very useful in water pressure (pump up) systems where the pressure may swing wildly for several seconds after a pump is turned off or on. If this time is set longer than the pressure takes to settle then no further pump calls will happen until the new pressure has stabilized.

3.2.1.5 FAIL TO START TEST

The PC-3000 shall be equipped with an optional fail to start test. This optional test is controlled by the START TEST time in the setup menu. If this time is zero then this test is disabled. If the start test is enabled then the AUX/DIS inputs for each pump must be connected through a dry contact to ground. These contacts must close and short the AUX/DIS input to ground when the pump is running. The auxiliary contact on the starter or a switch on the check valve arm can be used. If the start test is disabled (time = 0) then these inputs are pump disable inputs. For example let's assume that the test is enabled with a START TEST time of 15 seconds. When a pump is called a timer is started for that pump. If the timer reaches 15 seconds and the AUX/DIS input for that pump has not been shorted to ground then a fail to start test failure is set for that pump. The pump is then disabled and the next available pump is called in its place. This failure condition is displayed on the front panel and will remain active until reset by either a reset button or reset input. The high level alarm will also reset this condition. This is to make sure that a broken or misadjusted check valve switch does not cause an overflow.

3.2 ALTERNATION

The PC-3000 shall be equipped with an automatic alternation system which can be used to cause a different pump to be used each pump cycle. This is useful to equalize pump wear. When the alternator is off the lead pump can be selected and that pump will always be called first. The alternator on the PC-3000 is controlled by a toggle switch on the front panel. When the switch is in the up position the alternator is on and the lead pump will be changed each cycle. When the switch handle is in the center position the alternator is off and the lead pump is selected by pushing the handle down. The handle has a spring return from the down position. Each time the handle is pushed down the lead pump will be incremented to the next available pump. The current lead pump is displayed on the right side of the first line of the display (LP=2).

For systems with two pumps, alternation (if on) simply swaps lead pump duty between the two pump each pump cycle. If there are three pumps, alternation can be either of two options: In normal alternation, each pump cycle the next available pump is selected as lead so that if all pumps are available then each will be lead every third time. The other option is jockey pump. In this type of system pump 1 is a small pump and pumps 2 and 3 are large. The small pump (pump 1) is always the lead pump and the other two pumps alternate as lag and lag2. When either of the two large pumps is on the small one is turned off. This is useful in systems where demand can be low at some times and large at others.

3.4 STARTUP

When the PC-3000 is first powered up it shall execute an internal self-test. During this test many internal functions are checked and the displays are sequenced. The system is controlled by an

internal microcomputer which is monitored by a watchdog timer system which will restart the system in the unlikely event that the program fails to execute properly. After the self-test is complete several timers are started which prevent any relay outputs from activating until all of the system inputs have had a chance to settle and all of the input filtering has resolved to their proper values.

3.5 FRONT PANEL INDICATORS AND CONTROLS

The front panel includes eight LED lamps, a 32 character LCD display, 5 push buttons, one toggle switch and one adjustment knob. They have the following functions:

- PUMP 1 THRU PUMP 3 LAMPS
  These three green LED lamps indicate which pump is currently being called for.

- OFF LAMP
  This green lamp indicates that no pumps are currently called to run.

- HIGH LAMP
  This red lamp signals that the level is above the high set point.

- LOW LAMP
  This red lamp signals that the level is below the low set point.

- FLOATS LAMP
  This red lamp will be on if the system has had a float backup cycle since the last reset or power up.

- XDUCER LAMP
  This red lamp signals that the main level sensor input is outside of its normal range of 4 to 20 milliamps. This is useful for detecting transducer failures.

- ALT SWITCH
  The alternate switch will turn alternation on when up and off when in the center position. When it is pushed down the lead pump will be sequenced to the next available pump. The current lead pump is indicated on the first line of the display.

- MENU BUTTON
  This button is depressed and held for 10 seconds to enter the set point menu.

- UP / YES BUTTON
  This button has several functions depending on the mode of the controller. When the controller is in normal mode (not in one of the menus) this button causes the bottom line of the display to sequence between pump status and the three elapsed time meters. After 15 seconds the bottom line of the display always reverts to pump status in normal mode. When the controller is in one of the two menus this button is used to increment the current parameter being adjusted or to tell the system to save the new value.

- DN / NO BUTTON
  This button has several functions depending on the mode of the controller. When the controller is in normal mode (not in one of the menus) this button caused the bottom line of the display to sequence between the pump status and the three elapsed time meters. When the controller is in one of the two menus this button is used to decrement the current parameter being adjusted or to tell the system not to save the new value.

- MUTE / RESET BUTTON
  This button will reset any current latched up alarms such as temp fail or on floats. It will also silence the horn if an alarm is currently active.

- TEST / ADJUST BUTTON AND KNOB
  The function of these two operators depends on the mode of the controller. When the controller is in the normal (not menus) mode these operators are used to test the system. When the TEST button is depressed and held the ADJUST knob will be the level for the system. As you turn the knob up and down the level will go up and down. This will call on pumps and make alarms just as if the level was coming from the transducer. The controller shall switch back to the transducer 8 seconds after the button is released. When the controller is in one of the menus these operators are used to change the value of the set point or parameter. Depressing and holding the ADJUST button will cause the knob value to be placed in the current parameter or set point. This can be used along with the up and down buttons to easily adjust all of the set points.

- 32 CHARACTER DISPLAY
  This alpha-numeric display shall have two lines of 16 characters each. The first line always displays the current level in feet and the current lead pump. The second line depends on the mode of the controller. In normal mode this line displays pump status or the elapsed time meters. Pressing the up or down buttons will sequence through the three elapsed time meters. After 15 seconds this line will revert to pump status. When pump status is displayed
  the display will read ALL PUMPS OK if there are no pump faults. If there are pump fault, such as temperature failures or seal failures, they will be displayed one at a time every 2 seconds.
  In either of the two menus the second line of the display shows the parameter being adjusted and its current value.

3.6 SET POINT MENU

The set point menu is used to examine and change the on and off set points for the pumps and the high and low alarm set points. The menu in entered and updated using the following procedure:

- Depress the MENU button and hold it until the first set point appears on the bottom line of the display. This will take about 10 seconds.
- The display should say LEAD ON = XX.X FT. where XX.X is the current value for the lead pump on set point.
- If you wish to change this value then use the UP or DOWN buttons or you can hold the ADJUST button down and turn the ADJUST knob until the value is correct. After the value is correct then depress the MENU/NEXT button to go to the next set point.

- If you have changed the value then the displays will ask SAVE? (Y/N) If you wish to save the new value then press UP/YES if not then press DOWN/NO. The display should change to the next set point.
- The display should say LEAD OFF = XX.X FT. where XX.X is the current lead off set point. Repeat steps 3 and 4 above to make any changes you need to this set point.
- This process should be repeated until all of the set points have been examined and changed or until no further changes are required. Once all set points have been done the screen will return to normal mode or you can, at any time, hit the MUTE/RESET button and return to normal mode. If the system is setup for 2 pumps then the set points for the lag2 pump will be skipped in the menu. If the system is setup for only 1 pump then the set points for both lag pumps will be skipped. The set points are stored in electrically erasable programmable memory EEPROM which will not lose its contents when powered down. This is done every time the operator answers YES to the SAVE? (Y/N) prompt.

3.7 CONFIGURATION MENU

This menu is used to configure the PC-3000 controller for its application. This is normally only done once (when the panel is built or at startup) and would not be required again unless the configuration changed. This menu is entered using the following procedure:

- Depress the UP and DOWN buttons at the same time and hold them until the first setting is displayed on the bottom line of the display. This will take about 10 seconds.
- The display should say MAX LEVEL XX.X FT where XX.X is the current value. This parameter is the level when the level transmitter is at 20 mA. (full scale). For example if the transducer is a 10 psig submersible pressure transducer then 10psi is 23.1 feet so adjust this value to 23.1.
- If no change to this setting is required then press the MENU/NEXT button. To change this value we use the same procedure that we used on the set point menu. Use the UP or DOWN buttons or depress the ADJUST button while turning the ADJUST knob. After you have the value required depress the MENU/NEXT button to go to the next parameter.
- If the parameter has changed then the display will ask SAVE? (Y/N). If the value is correct then press the UP/YES button to save it, or press the DOWN/NO button to continue without saving the new setting.
- The display should say OFFSET XX.X where XX.X is the current value. This parameter is the level when the level transmitter is at 4 Ma. For example if the transmitter is a submersible pressure transducer mounted 6 inches off of the floor of the wet well then this setting should be 00.5 ft. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.
- The display should say HOW MANY PUMPS X where X is the current max number of pumps. If this is a duplex station set this to 2. If it is a triplex station then use 3. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.
- The display should say START DELAY XXXS where XXX is the current delay between pump starts. This parameter is the minimum time between starting one pump

and then starting another. It is set in seconds from 0 to 255. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.

- The display should say STOP DELAY XXXS where XXX is the current delay between pump stops. This parameter is the minimum time between stopping one pump and then stopping another. It is set in seconds from 0 to 127. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter
- The display should say TIME AT SP XXXS where XXX is the current set point time. This parameter is the minimum time a set point condition must be continually met for the required action to take place (for example starting a pump). It is set in seconds from 0 to 31. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter
- The display should say PUMP UP/PUMP DN XX where XX is the current setting. This parameter determines the overall pump mode of the controller. If you have a lift station then set it to DN. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.
- The display should say BACKUP TIME XXXS where XXX is the current float backup time. This parameter is the time period after the high float comes out of the water that the pumps will remain on. To disable the float backup system set this to 000. It is set in seconds from 0 to 255. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter
- The display should say START TEST XXXS where XXX is the current start test delay time. This parameter is the maximum time delay between a pump being called and the confirming pump run signal (on the AUX/DIS input). To disable the fail to start test set this to 000. It is set in seconds from 0 to 63. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter
- The display should say SEAL XXX YYY. This parameter is use to setup the mode of the seal fail inputs. Use the UP and DOWN buttons to select between the options available. The options are:

a) SEAL NORM AUTO R
In this mode the seal fail input is set to cause a failure if the resistance to ground is less than 50,000 ohms and the alarm will auto reset if the alarm condition clears.

b) SEAL NORM LATCH
In this mode the seal fail input is set to cause a failure if the resistance to ground is less than 50,000 ohms and the alarm will latch up and must be cleared by the MUTE/RESET button.

c) SEAL INVR AUTO R
In this mode the seal fail input is set to cause a failure if the resistance to ground is greater than 50,000 ohms and the alarm will auto reset if the alarm condition clears.

d) SEAL INVR LATCH
In this mode the seal fail input is set to cause a failure if the resistance to ground is greater than 50,000 ohms and the alarm will latch up and must be cleared by the MUTE/RESET button.

Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.

- The display should say TEMP XXX YYY. This parameter is use to setup the mode of the temperature fail inputs. Use the UP and DOWN buttons to select between the options available. The options are:

a) TEMP NORM AUTO R
In this mode the temp fail input is set to cause a failure if not shorted to ground and the alarm will auto reset if the alarm condition clears.

b) TEMP NORM LATCH
In this mode the temp fail input is set to cause a failure if not shorted to ground and the alarm will latch up and must be cleared by the MUTE/RESET button.

c) TEMP INVR AUTO R
In this mode the temp fail input is set to cause a failure if shorted to ground and the alarm will auto reset if the alarm condition clears.

d) TEMP INVR LATCH
In this mode the temp fail input is set to cause a failure if shorted to ground and the alarm will latch up and must be cleared by the MUTE/RESET button.

Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter

- The display should say AUX R XXX
This parameter is use to setup the function of the auxiliary relay output. Use the UP and DOWN buttons to select between the options available. The options are:

a) HORN
The aux relay is for an audible alarm (horn).
b) SEAL
The aux relay will close if there is a seal fail condition on any pump.
c) TEMP
The aux relay will close if there is a temperature fail condition on any pump.
d) SEAL / TEMP
The aux relay will close if there is a seal fail or a temperature fail condition on any pump.

Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter

- The display should say ALTERNATE XX where XX is the current setting. This parameter determines what type of alternation will be used. If the controller is set for 1 or 2 pumps then this parameter is not used. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter. The options are:

  a) NORMAL
  The controller will use normal sequential alternation (1-2-3, 2-3-1, 3-1-2).
  b) JOCKY
  The controller will use single jockey pump alternation. Pump 1 is lead, the other two pump alternate and pump 1 is turned off if pump 2 or 3 is on.

- The display should say MAX ON AT ONCE X where X is the current max number of pumps which can be on at the same time. This would normally be set to the number of pumps the station has unless some factor (such as available power) prevents proper operation with all pumps running at the same time. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.

- The display should say A OUT LOW XX.X FT. where XX.X is the level at which the analog output signal is at its minimum or 4 Ma. This parameter and the next one set up the proportional scaling of the analog output of the PC-3000. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.

- The display should say A OUT HI XX.X FT. where XX.X is the level at which the analog output signal is at its maximum or 20 Ma. Use the procedure in steps 3 and 4 above to make any changes and depress the MENU/NEXT button which will complete setup and return you to the main display.

4.0 SPECIFICATIONS

a) General specifications:
b) SIZE H = 5.9" W = 7.2" D = 3.5'
c) WEIGHT 1.8 LB
d) OPERATING TEMPERATURE -20 C TO +70 C
e) STORAGE TEMPERATURE -30 C TO +80 C
f) INPUT POWER 120 +/- 10% 50-60 Hz. 0.3 Amp max.

4.1 INPUT SIGNALS

The PC-3000 shall have one analog input (from the level or pressure transmitter) and eleven discrete inputs. They shall be transient protected and use both electronic and software filters to reduce noise and improve reliability.

4.1.1 TRANSDUCER INPUT

This is an analog 4-20 Ma. input which serves as the level sensing input for the controller. A 125 ohm resistor is used to convert the current input to a voltage which is converted to digital information using a 12 bit analog to digital converter. If the input signal is greater than 20 mA. or less than 4 mA. then a transducer error lamp on the front panel will illuminate. The level data is processed through a 16 stage rolling average filter in the microcomputer to reduce sensitivity to wave action and other noise. Figure 4 show how this input is connected to a loop powered transducer.

a)	INPUT IMPEDANCE	125 OHM
b)	MAXIMUM VOLTAGE	0 TO 2.5 VDC
c)	LEVEL ACCURACY	+/- 0.5 %

4.1.2 SEAL FAIL INPUTS

The PC-3000 has 3 inputs for the leak sensors commonly found in submersible pumps. These microcomputer measures the resistance from the input to ground to determine if a leak has occurred.

a)	VOLTAGE WHEN OPEN	5.0 VDC
b)	CURRENT WHEN SHORTED	0.5 MA

4.1.3 TEMPERATURE FAIL INPUTS

The PC-3000 has 3 inputs for the over-temperature sensors commonly found in pump motors. These inputs are designed to detect a short to ground.

a)	VOLTAGE WHEN OPEN	5.0 VDC
b)	CURRENT WHEN SHORTED	0.5 MA

4.1.4 AUX / DISABLE INPUTS

The PC-3000 has 3 inputs which can either be run confirming inputs or pump disable inputs. These inputs are designed to detect a short to ground.

a.	VOLTAGE WHEN OPEN	5.0 VDC
b.	CURRENT WHEN SHORTED	0.5 MA

4.1.5 MUTE/RESET and HIGH FLOAT INPUTS

The PC-3000 has 2 inputs which are for the high float and for the MUTE button in the panel. These inputs are designed to detect a short to ground.

a)	VOLTAGE WHEN OPEN	5.0 VDC
b)	CURRENT WHEN SHORTED	0.5 MA

4.2 OUTPUT SIGNALS

The PC-3000 has one analog output, one loop supply output, and six relay outputs.

4.2.1 ANALOG OUTPUT

This is an analog 4-20 Ma. which is proportional to the system level. It is self powered, referenced to ground and not isolated.

a) MAXIMUM VOLTAGE OUT 10 VDC

4.2.2 LOOP POWER SUPPLY

This output is a 24 VDC output intended to power a level transmitter. It is not isolated and is referenced to ground.

a) VOLTAGE OUT 22 TO 28 VDC
b) MAXIMUM CURRENT 30 mA.

4.2.3 RELAYS

The PC-3000 has 6 form A (SPST) relay contacts which are used to control horns, lights, and motor starters.

a) MAXIMUM VOLTAGE 140 VAC
b) MAXIMUM CURRENT 3 AMPS

5.0 CONNECTOR PINS

5.1 CONNECTOR J1 (POWER AND COMMUNICATION)

PIN	FUNCTION
1.	MAIN POWER IN HOT TERMINAL (120 VAC)
2.	MAIN POWER IN NEUTRAL TERMINAL
3.	MAIN POWER IN GROUND TERMINAL
4.	EMERGENCY +12 VDC POWER INPUT
5.	RS-232 TRANSMIT TERMINAL
6.	RS-232 RECEIVE TERMINAL
7.	GROUND
8.	ANALOG OUT 4-20 mA. OUTPUT
9.	GROUND
10.	+12VDC OUTPUT (0.1 AMP MAX)
11.	GROUND
12.	GROUND

5.2 CONNECTOR J2 (RELAYS)

PIN	FUNCTION
1.	AUX RELAY COMMON TERMINAL
2.	AUX RELAY NORMALLY OPEN TERMINAL
3.	HIGH ALARM RELAY COMMON TERMINAL
4.	HIGH ALARM NORMALLY OPEN TERMINAL
5.	PUMP 3 RELAY COMMON TERMINAL
6.	PUMP 3 NORMALLY OPEN TERMINAL
7.	PUMP 2 RELAY COMMON TERMINAL
8.	PUMP 2 NORMALLY OPEN TERMINAL
9.	PUMP 1 RELAY COMMON TERMINAL
10.	PUMP 1 NORMALLY OPEN TERMINAL
11.	LOW ALARM RELAY COMMON TERMINAL
12.	LOW ALARM NORMALLY OPEN TERMINAL

5.3 CONNECTOR J3 (INPUTS)

PIN	FUNCTION
1.	GROUND
2.	PUMP 1 AUX / DISABLE INPUT
3.	PUMP 3 OVER- TEMPERATURE SENSOR INPUT
4.	PUMP 2 OVER- TEMPERATURE SENSOR INPUT
5.	PUMP 1 OVER- TEMPERATURE SENSOR INPUT
6.	PUMP 2 AUX / DISABLE INPUT
7.	PUMP 3 AUX / DISABLE INPUT
8.	HIGH FLOAT INPUT
9.	MUTE / RESET BUTTON INPUT
10.	PUMP 1 LEAK SENSOR INPUT
11.	PUMP 2 LEAK SENSOR INPUT
12.	PUMP 3 LEAK SENSOR INPUT
13.	ANALOG INPUT SENSE RESISTOR RETURN (connect to ground)
14.	GROUND
15.	ANALOG INPUT (for loop powered devices connect to – terminal)
16.	+24 VDC LOOP POWER (for loop powered devices connect to + terminal)

NOTES:
a) HEADER AND PLUGS USE COPPER CONDUCTORS ONLY.
b) TORQUE REQUIREMENT 1.47 FT.LB.
c) THIS UNIT OPERATES AT “POLLUTION DEGREE 2”.

6.0 Inner Door Devices

The following devices shall be operable or viewed through the inner door to prevent operator exposure to live

electrical current:

a) Hand-Off-Auto selector switches to override automatic mode control.
b) Run lights.
c) Ground fault protected, 115V convenience receptacles.
d) Elapsed time meters for each pump.
e) Elapsed time meter for concurrent pump run time.
f) Pump circuit breakers for each pump.
g) Main circuit breaker, if required.
h) Manual Transfer with sliding bar mechanical interlock (includes main circuit breaker)

7.0 Pump Breakers

All electrical circuits shall be protected by molded case circuit breakers. Each pole of the breaker shall provide inverse time delay overload protection and instantaneous short circuit protection by means of a thermal magnetic element.

The breaker shall be operated by a toggle type handle and shall have a quick make, quick break switching mechanism that is mechanically trip free from the handle. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual "on" and "off" position. Breakers shall be completely enclosed in a molded case and shall bear the UL label. Short circuit interrupting duty (18 KAIC minimum) rating for all motor protection circuit breakers shall be applicable for operating conditions. Substitution of fuses to replace circuit breakers is not acceptable. Circuit breakers shall be operable through the inner door to prevent exposing the operator to live power.

- The acceptable manufacturer is Square D only.

8.0 Motor Starters

All starters shall be full-voltage non-reversing NEMA rated (Size 1 minimum) and bear a UL label. The coil operating voltage shall be 120 volts AC 60 Hz. IEC rated starters will not be accepted due to a reduced life expectancy. All starters shall be complete with ambient compensated overload relays. The overload relays shall be equipped with an electrical isolated normally open contact to annunciate a tripped overload due to a motor overload condition.

- The acceptable manufacturer is Square D only.

9.0 Control Relays

Relays shall be of the square base plug in type Mechanical "relay status" indicator and rated for 5 amps at 250VAC. All relays shall have a transparent polycarbonate dust cover to protect the contact surfaces from airborne dust and other contaminants. Relays shall be rated for continuous duty operation. Relay sockets shall have screw terminals with self-lifting clamps and terminal identification numbers located at each connection on the relay socket.

- The acceptable manufacturer is Square D only.

10.0 Submersible Transducer

The submersible transducer shall utilize a piezoresistive sensing element encased in a 316 SS cage style housing, 316 SS diaphragm, 270# tinsel strength shielded & vented polyurethane cable, repeatability and hysteresis shall be +/-25% full scale, 4-20 ma DC, 13-30 VDC, internal lightning and surge protection, replaceable vent filter

- Acceptable manufacturers include Mercoid / Dwyer or approved equal.

11.0 Pilot Light Indicators

All pilot lights shall UL listed and incorporate replaceable LED bulbs rated for 120 VAC. The lamps shall be self-insulated and capable of operating for a minimum of 25,000 life hours.

- The acceptable manufacturer is Square D only.

12.0 Phase Monitor Relay

The phase monitor shall protect 3-phase pumps against phase loss, under voltage, and phase reversal conditions. With normal operating voltages applied in the proper ABC sequence, the internal relay will energize (PICK-UP). When incorrect phase sequence or phase loss occurs or the three-phase voltages fall below the drop out voltages, the relay will de-energize (DROP-OUT). On models featuring indicators, the LED glows when all line conditions are normal. Both Delta and Wye systems may be monitored. In Wye systems, connections to neutral are not required. For UL Listed units, with field wiring terminals, copper wire with 60°/75°C rating must be used for control circuitry connections.

- The acceptable manufacturer is Diversified Electronics only.

13.0 Elapsed Time Meters

A elapsed time meter shall have 6 digits measuring hours and tenths of an hour of operation shall be provided for each pump and a concurrent meter to accurately record the amount of time the both pumps ran together to more accurately track the requirements of the system. The time meter shall operate from the control voltage of the motor starter. The meter shall be totally sealed and have a quartz accuracy +/- 2% over the life time of the meter.

- The acceptable manufacturer is Redington only.

14.0 Lighting Arrestor/ Surge Arrestor

A lighting/surge arrestor shall be provided at the service entrance to the control panel. The Secondary Surge Arrester (commonly known as a lightning arrester) shall incorporate the latest MOV technology.

The devise shall incorporate the following:
• UL Listed as TVSS; UL and C-UL as secondary surge arrester
• Meets ANSI/IEEE C62.11-1987
• Suitable for use in Category B and C locations

• Metal oxide varistor (MOV) design
• LED indicates operational status
• Fast response time
• Maintenance-free, long life

Housing
The arrester housing is made of high temperature thermoplastic. The cover is permanently bonded to the housing by an ultrasonic welding process, and the wire exit is sealed using a potting compound. The arrester can be used for both indoor and outdoor applications.

MOV Technology
MOVs provide voltage surges with a low resistance path line-to-neutral while providing high resistance to the 50/60 Hz power source. Traditional gas tube arresters suffer from slow response time, high clamping voltages, and crow barring effects (the reduction of voltages during conduction in order to short circuit the load). The MOV responds faster and has a lower clamping voltage because it does not have a gap structure.

Fuse Links and Thermal Cut-offs
Individual non-replaceable internal fuse links and thermal cut-offs protect the MOVs and open in the event of a varistor-damaging overload. Silica inside the arrester housing reduces the risk of one fuse damaging another when it opens.

LED Indicator
The LED on the face of the device indicates operational status of the arrester. If the light is on the device is fully operational. When the LED indicator goes off, the device should be replaced.

- Square D Model SDSA3650 only.

15.0 Transformers

a) All transformers shall be the dry type and shall be designed and tested in accordance with the latest applicable standards of ANSI, IEEE and NEMA, and shall be UL listed.
b) Large transformers that generate a large amount of heat are to be mounted external to the control panel to minimize component degradation due to excessive heat.
e) 480/120 VAC Transformer, 2 KVA, 480/120 VAC, NEMA 4X SS (mounted external to the panel)
f) 120/24 VAC Transformer, 50 VA (to power Pump manufacturers moisture relay if required)
g) The 120/24 VAC transformers, 50 VA (open style mounted inside the panel to power the pump manufacturer's OT/Moisture relays)

- The acceptable manufacturer is Square D.

16.0 Convenience Receptacle

A GFI receptacle shall be provided to protect against ground fault leakage and shock. The unit shall have a retractable ground pin and polarized blades for two (2) or three (3) wire receptacles. The unit shall require a reset after any ground fault interruption.

17.0 Alarms

High and Low Level alarms shall be available with a silence push button. On decreasing levels, the alarm condition will automatically reset when the level falls below the high level alarm set point. On increasing level, the low level alarm shall automatically reset when the level rises above the low level alarm set point.

18.0 Hand - Off - Automatic Switch

Standard HOA switches shall be supplied on the inner door for each pump. The switches shall be UL listed and rated for 600 VAC, 10 amp

19.0 Moisture/Seal Failure Relays

a) An MSR providing thermal protection for each pump shall be supplied by the pump manufacturer to be factory installed and tested by the panel manufacturer to ship as part of a complete package by the panel manufacturer.

b) The MSR senses moisture in the pump the seal failure relay shall not shut down the pump but shall illuminate a red LED pilot light located on the inner door that shall correspond to the appropriate pump.

21.0 Over Temperature Sensing Relays

a) An OTR providing thermal protection for each pump shall be supplied by the pump manufacturer to be factory installed and tested by the panel manufacturer to ship as part of a complete package by the panel manufacturer. The OTR senses the status of the pumps internal over temp circuit. In the event that the OT circuit changes status the OTR will shut down and lock out the pump while illuminating a red LED pilot light located on the inner door that shall correspond to the appropriate pump. The pump shall remain locked out until a manual reset button located on the inner door that corresponds to the appropriate pump has been reset.

22.0 Quality Assurance

The control system manufacturer must meet the following requirements.

a) The manufacturer of the control system shall be certified by Underwriters Laboratories (UL) as being a UL 508A and 698A listed manufacturing facility and certified to install a serialized label for quality control and insurance liability considerations.

b) The manufacturer of the control system must be able to document ten years of experience in successfully designing and manufacturing similar control systems for wastewater pumping applications.

c) The manufacturer shall have an authorized stocking distributor with 24 hour service available within a100 mile radius of the installation.

d) The distributor must maintain a minimum of two of the controllers being specified to minimize down time.

23.0 Manufacturer Quality Control

The complete control system shall be functionally tested at the manufacturing facility and certified as a complete system to assure proper operation per specification. All components must be mounted with stainless steel hardware.

24.0 Manufacturer Approval

Manufacturers listed in this specification do not constitute approval. All controls must have the capabilities and functions as outlined in the specifications.

25.0 Submittal Requirements

25.1 Base Bid

The base bid control system shall be the PC-3000 system as manufactured by Best Controls Inc. of Clearwater, Florida. All bidding contractors shall base their bid on the PC-3000 control system. Contract shall be awarded on the base bid control system. Alternative deductive systems will be considered only after contract award and must be specified with any applicable deducts at bid time in order to receive consideration. Bidders submitting alternate quotations shall submit appropriate cut sheets, circuit drawings and a detailed bill of materials with their alternate bid packages. Approval of an alternative system shall be at the sole discretion of the Owner's Representative and the City of Galveston. All equipment and materials shall be new and shall be specifically designed for the function herein.

26.0 Substitutions

The Owner's Representative will consider proposals for substitution of materials, equipment, methods and services only when proposals are accompanied by full and technical data and all other information required by the Owner's Representative for the proposed substitution. Substitution of materials, equipment, methods and/or services is not allowed unless such substitution has been specifically approved by the Owner's Representative.

27.0 Shop Drawing Submittals

27.1 Drawing Requirements

All drawings are to be of the computer generated class.

27.2 Engineering Approval

The Owner's Representative reserves the right to approve or disapprove any and all equipment based upon his evaluation. Approval for fabrication and installation will be made only after submittal and review of all shop contract documents. The information required for approval shall include the following items and be provided in (8) sets as a minimum:

a) Appropriate cut sheets
b) Complete electrical schematics detailing the system

c) A complete bill of material
d) Detailed drawings of the enclosure
e) Exploded detail of every control faceplate, light, switch or meter mounted on the exterior of the enclosure.

28.0 Start up And Testing

a) Eight (8) sets of as built drawings including any field modifications made by the authorized start-up personnel during installation, start-up or testing.
b) The equipment is to be started up by the manufacturers authorized representative.

29.0 Warranties

All components in the specified control system shall have a minimum, a comprehensive, parts only, twelve (12) month guarantee against defects in workmanship and material from the date of start up or eighteen (18) months from the date of shipment from the manufacturers facility. The manufacturer of the control system shall warrant all components in the system for unit responsibility purposes.

END OF SECTION

SECTION 16000

SPECIFICATIONS REFERENCES, MATERIALS AND SUPPLIERS

PART 1 REFERENCES

A. Unless otherwise noted within individual specifications contained in Division 16, these specifications comply with those specified by the Texas Department of Transportation (TxDOT) in the 2004 Standard Specifications Book. For comparison, the City Specification Item 16XXX corresponds to the TxDOT Item XXX. Additional information concerning these and related specifications can be obtained from TxDOT's website at the following location:

1. http://www.dot.state.tx.us/business/specifications.htm

PART 2 MATERIALS SPECIFICATIONS

A. TxDOT has developed guidelines for evaluating and using pavement marking, signing, electrical, illumination, and traffic signal materials and equipment that may be referenced in construction specifications contained in contracts or requisitions. Additional information concerning these guidelines can be obtained from TxDOT's website at the following location:

1. http://www.txdot.gov/business/contractors_consultants/material_specifications/dms_series.htm

PART 3 MATERIAL PRODUCER LISTS

A. TxDOT has developed lists of approved manufacturers or producers of various products and materials based on pre-qualification procedures referenced in Section 16000, Part 2. Additional information concerning these pre-qualified suppliers and materials can be obtained from TxDOT's website at the following location:

1. http://www.dot.state.tx.us/business/contractors_consultants/producer_list.htm

END OF SECTION

Section 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Basic requirements specifically applicable to the work of Division 16 - Electrical Requirements.

B. The Contractor shall furnish equipment, materials, and labor for assembly and installation plus check-out and start-up of the complete electrical system as shown on the Drawings and stipulated in the Specifications.

1.02 REFERENCES

A. As a minimum requirement, the electrical system shall be constructed in accordance with:

1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC).

2. City of Galveston Building Code.

3. Other applicable Codes and Standards as referenced in other Master Specifications.

B. Comply with local, county, state and federal regulations and codes in effect as of date of purchase.

C. Equipment of foreign manufacture must meet U.S. codes and standards.

D. Equipment and materials shall conform to requirements of specification and to the criteria provided in data sheets for the project.

1.03 QUALITY ASSURANCE

A. Product Conformance Certificate and Quality Assurance Release. Submit an overall conformance certificate for electrical components signed by the person responsible for product quality. Specifically identify the purchased material or equipment by project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. Indicate that all requirements have been met and identify any approved deviations.

B. Field Inspection

1. Electrical work shall be inspected and approved by the local code inspector, the wastewater inspector, and the Project Manager prior to starting the 7-day test or scheduling training.

2. Contractor shall give a minimum of one day notice to the Inspector that the installation is ready for inspection and two days notice to the Project Manager.

3. Concealed work shall be inspected before it is covered:

   a. Conduit with stub-ups, underground in duct banks before concrete is poured.

   b. Conduit in slabs, walls and ceilings, complete with boxes.

4. Electrical equipment and materials shall be inspected upon arrival by the Project Manager for compliance with specifications.

1.04 SITE CONDITIONS

A. Take the following site conditions into consideration when fabricating, erecting, installing and wiring electrical equipment under this contract:

1. Plant Location Galveston, Texas

2. Plant Type and Size

3. Plant Site Elevation

4. Seismic Zone Zone 0

5. Wind Velocity mph

6. Temperature, Min./Max.:

• Coldest Winter Month	High 60 degrees F	Low 41 degrees F
• Warmest Summer Month	High 94 degrees F	Low 73 degrees F
• Lowest Expected	11 degrees F	
• Highest Expected	107 degrees F	

7. Rainfall:

   - Annual 45 inches
   - Design 3.4 inches/hour, 8.4 inches/24 hours

8. Design Relative Humidity: 98%

9. Station Barometric Pressure:

   - Average Annual 29.5 inches Hg Absolute.

10. Utility Water Systems: Design Pressure Design Temp.

    - River Water _____ PSI _____ degrees F
    - Well Water _____ PSI _____ degrees F
    - City Water _____ PSI _____ degrees F

11. Electric Power Supply Characteristics (Available to Contractor):

	Voltage	Phase	Hz	Wire	Delta or Wye
1					
2					
3					

PART 2 P R O D U C T S

2.01 COMPONENT DESIGN

A. Components utilized in the construction of the material or equipment shall be of the latest proven design, new and in current production. Do not use obsolete components or components to be phased out of production.

2.02 FACTORY INSPECTION

A. Provide free access with prior notice for the Project Manager at all times to the shop where the material or equipment is being fabricated or tested. Provide reasonable facilities for inspection, witnessing tests, and examining records. Give 7-days notice prior to starting tests which are scheduled for factory inspection.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify dimensions and ratings of equipment and materials to ensure proper fit and performance.

3.02 INSTALLATION

A. Install equipment and materials in accordance with the Drawings and manufacturer's written instructions. If field conditions necessitate changes in electrical installation, obtain approval from the Owner’s Representative.

3.03 DEMONSTRATION

A. Test the electrical system to specification requirements and to demonstrate correct installation and operation of equipment.

B. Before 7-days test, demonstrate the system to the wastewater inspector and the Project Manager. Show the system to be fully operational. All alarms, safeties, and communication points to central and locally must operate in both full-automatic and back-up modes. Use fresh water in the test medium.

C. Operate the system continuously for a period of 7 days in full automatic, without failure, to qualify as acceptable. "Failure" is considered any problem that requires correction by maintenance personnel, such as: high or low water level, any motor alarm, power failure, phase failure, communication failure, control system failure or transducer failure. This would exclude conditions not under the control of Contractor, such as: evident lightning strikes, 25-year rains or local power utility power failures. Failures due to uncontrollable situations would allow the 7-day test to continue, as soon as test conditions are restored and the Owner’s Representative is notified.

D. If the project is for the replacement of an existing lift station the existing station shall remain in service during this test.

END OF SECTION

SECTION 16012

ELECTRICAL WORK

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision electrical work.

B. Contractor shall verify requirements of Item 2.1 – Materials before bidding.

C. Contractor to conform to Item 1.6 – Contractor Qualifications of this specification before bidding.

D. General Contractor is solely responsible for coordinating all electrical requirements of all equipment installed under this contract. Electrical Subcontractor shall confirm this with General Contractor before bidding. Within 10 days of "Notice to Proceed," the General Contractor shall appoint a person responsible for coordination of all electrical controls and equipment that are a part of this project and shall, at that time, notify Engineer in writing of that person's name, telephone number, fax number, address, and all other pertinent information.

E. This specification section is an inherent part of all work performed on this project and its contents shall apply for any and all electrical power, control and instrumentation related work. Contractor shall advise all Subcontractors and Vendors accordingly.

F. Warning: Electrical systems for this project have lethal voltages present. Contractor shall not work on energized equipment except when absolutely necessary and then only in the presence of another trained, experienced Electrician and with proper protective gear. See Item 1.6 – "Contractor Qualifications" for safety training requirements.

G. All correspondence, RFI's, and submittals concerning electrical, instrumentation, and controls matters shall be from General Contractor and shall have statement that General Contractor has verified the correctness or validity of the correspondence, etc. in respect to contractual requirements of the plans and specifications. Any correspondence, etc. not having this statement or, determined to be covered in the requirements of the plans and specifications will not be responded to and, the Contractor shall be fully responsible for any action or non-action thereof.

H. All references to "days" in the electrical, mechanical, instrumentation, and controls specifications means "working days." All prequalification under this specification shall be submitted no later than ten (10) days prior to bid date.

I. Installation shall conform to most recent National Electrical Code, International Building Code, and Local Codes. In addition, Contractor shall follow all requirements of NFPA 70E - "Standard for Electrical Safety in the Work Place." Of specific importance are all the requirements of Article 400.11 – "Flash Protection."

J. Plans and diagrams are illustrative and may not contain all devices wiring and controls required to perform the function intended without reference to Specifications. Location and alignment of motor control centers or other equipment shown on Plans may require adjustment for some Equipment Manufacturers products, and this requirement is the Contractors sole responsibility.

K. Substitutions for equipment specified or shown on plans shall be as pre-approved prior to bidding unless specified or shown on plans as “or equal” or “approved substitution”. Where noted as “pre-approved,” indicates approval is required prior to bid acceptance.

L. All software or programs provided by any Vendor or Contractor shall be open activation without undisclosed passwords, keys, and/or means or devices that prevent Owners access to programs. All software shall be new copies for Owner with no cost attachments. No exceptions.

M. All references to plans and/or drawings refer to the complete set of contract plans and not specifically electrical only, unless stated otherwise.

N. Additions or modifications to existing facilities involves a certain degree of uncertainty and all existing, hidden or unknown conditions may not appear on plans. Contractor is to consider this when bidding and shall cover all reasonable unknown conditions not evident in pre-bid site visit, which is necessary to familiarize Contractor with observable pre-existing conditions. Contact Engineer concerning any questions prior to bidding job.

O. Control panels shall be fabricated to fit the available space shown on plans. This may require special enclosures. Relocation up to 40 feet from where shown on plans may be required and shall be included in bid cost. Listing of acceptable Equipment Manufacturers does not limit or remove the intent of this requirement.

P. All devices, fittings, connectors, supports, brackets, and miscellaneous hardware normally used for installation of electrical equipment may not be shown in detail. Contractor shall provide all these items and included them in bid price.

Q. Any change orders or additional work beyond the scope of this project as bid by Contractor shall be approved in writing by Engineer. Any unapproved work performed is at Contractor’s risk.

R. Installation shall conform to layout, routing, and details shown on Plans and described in Specifications. Any variations shall be pre-approved in writing by Engineer before work starts. Any unauthorized work shall be removed at Contractor’s cost and with no delay in project schedule.

1.2 DESCRIPTION

A. The work shall include providing materials and equipment required for installation of a complete and functioning electrical system as specified and as shown on the drawings.

B. This section is an integral part of all Specification Sections related to electrical, control and instrumentation construction under this contract. Contractor shall check all other plans and specifications for this project and include items and circuits accordingly. The total set of construction documents make up the requirements for work for this project and shall be included in Contractor’s bid at no additional cost to Owner or Owner’s Representative.

C. All plans and specifications for this project are representative of the design intent and may not contain minute details associated with normally accepted electrical construction, as described in applicable codes or as described in manufacturer’s literature. Contractor shall provide all appurtenances normally associated with a particular equipment or device, and as required for a proper operating system. Some devices, equipment or materials may appear in only one location on the plans or in the specifications. Each and every item shown or described is to be included for this project. No exceptions. All required circuits and devices necessary for intended operation are to be included without additional cost to Owner. Where discrepancies occur between various plans or specifications for this project and where clarification is not requested by Contractor prior to bidding, the most stringent requirement shall be included in the Contractors bid price. Contractor shall review all specifications for all trade disciplines with electrical requirements prior to bidding and shall include most stringent and higher cost requirements in bid price. No elements or requirements of the plans or specifications shall be omitted in Contractor’s bid price unless specifically deleted in writing by Engineer. Failure to follow this specification requirement is at Contractor’s expense and at no additional cost to Owner.

D. For equipment structures and lift stations, install receptacles at 48 inches AFG or platform, where applicable. Install receptacles and light switches at ADA required heights.

E. Prior to bidding and during construction, Contractor shall coordinate with equipment vendors and suppliers and determine requirements for power, control and interconnection wiring and shall provide conduits and conductors accordingly for a complete operating system.

F. All electrical work shall be performed only by a Texas State Licensed Electrical Contractor, and as listed in Item 1.6 – "Contractor Qualifications" of this Section.

1.3 MAJOR ITEMS OF WORK AS FOLLOWS

All work shown on plans and described in specifications including as follows:

A. Installation of control panel.

B. Installation of lighting and receptacles.

C. Installation of pump motor feeders and terminal boxes.

D. Installation of electrical service equipment.

E. Installation of autosensory controls.

1.4 CONTROL SYSTEM

A. The Contractor shall furnish and install a complete operating control system. The 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 relays, programmable controllers, alarm light and horn, push buttons, control transformer, electronic devices, sensors, interlock wiring, control relays, blocks, snubbers, valves, nameplates, and all other associated items required to provide a workable system. All control circuits to be "fail-safe" type. All motor starters to have ETM, HOA, restart time delay relay, and run light as a minimum. All motor controls to have phase fail relay contacts to protect from single phasing.

B. Provide circuit conductors, conduits, circuit breakers, and related devices for furnishing power to all motor heaters, instruments, devices, lights, controls, and all other motors and equipment indicated on plans or provided by Vendors or others for this project. Provide circuits and related devices per Code.

C. Control diagrams shown on plans are illustrative in nature and may require additional devices such as time delays, relays, and other devices required for the intended control functions.

D. All controls shall be fully tested in shop for proper and satisfactory operation, prior to installation at site. Contractor to provide written certification before delivery to site. Any installations without certification notice are done at risk by Contractor, who shall be obligated to make all necessary corrections in field at no additional cost to owner.

E. Where any equipment includes a Manufacturer furnished control panel the Equipment Vendor or Manufacturer shall be responsible for coordination of all interconnecting wiring at related devices.

F. Provide interlock circuits between vendor furnished equipment and control panels. Coordinate with each vendor. Do not submit control panels until interlocks are coordinated.

G. All multiple pump installations shall have means of alternating pumps and provisions for bypassing pumps not in service in primary and backup mode of operation.

H. All multi pump lift station controls to have separate elapse time meter to record flow time of both pumps simultaneously.

I. All CT's to have load (burden) resistor for safety.

J. All control device settings are to be adjusted by Contract for values recommended by the Owner's Representative. Contact Engineer for clarifications.

K. Provide separate phase fail relay for each individual motor circuit.

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01300, Submittals.

B. Submit all products covered under all sections for Engineer's approval. Any items not submitted are the total responsibility of the Contractor. If it is not submitted, it is not approved. Requirements of this section apply to all other electrical instrumentation and control related specifications for this project. All submittal covers must have Electrical Engineer's project number and Prime Engineer's project number marked clearly on front of submittal. In addition, submittal cover shall have name, address, and telephone number of General Contractor, Electrical Subcontractor, or Subcontractor making submittal and the local Manufacturer Representative. Local Representative shall verify that equipment or materials submitted conform to the plans and specifications before shop drawings are submitted to Engineer. All shop drawings submitted that do not strictly comply with this section will be rejected and returned un-reviewed.

C. Where submittals for a particular equipment, device or material item vary from that specified or shown on plan drawings, and where that item is not specifically noted as acceptable and, where installation of submitted item results in improper or undesirable operation of the system, Contractor shall be liable for removal and/or replacement of that item with the item specified or shown on plan drawings at no additional cost to Owner. Such items submitted as substitutions shall be listed separately and clearly noted as "Substituted Item". Do not include Manufacturer's catalog data pages that do not apply to specific equipment or devices used for this project.

D. Provide Table of Contents, Materials List, and data pages that are tabulated in an orderly manner that allow easy identification and purpose of equipment or devices.

E. Where various equipments interface or have wiring inter-connections, submittals for all of the equipment shall be made simultaneously. For example MCC and controls, starters and motors, etc. Submittals for motors or starters not submitted together will not be reviewed. No sections, equipment or devices shall be omitted. This includes field wiring in ductbanks or conduit and local wiring. Submittals not complying shall be returned, unchecked, marked "Rejected".

F. Submittals of motor control and electronic device shop drawings will require a minimum of two (2) weeks for review from time of receipt by Engineer. Contractor shall submit all shop drawings in time to account for this period of review.

G. Provide CAD files of all diagrams, equipment views, and material and device schedules on CD and include with submittals. Only one (1) CD required for Engineer.

H. With each submittal, include an electronic 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.

I. Contractor is fully responsible for coordinating/submitting correct operating voltage, horsepower, current, phase and starter sizes requirements of all equipment furnished and installed under this contract. Shop drawing

review by Engineer does not remove this responsibility. Incorrect submittal information is at risk of Contractor and at no additional cost to Owner.

J. All submittals for motor control centers, control panels, control sections, controllers, lift pump panels, and Vendor furnished panels must contain statement of U.L. certification and identifying name and number of U.L. certification for fabricating shop. All submittals without this information will be rejected. Any panels installed without U.L. listing and where not acceptable by Engineer or Owner will be replaced at cost of Contractor.

K. Each submittal shall contain statement that all equipment for this project have been coordinated in respect to motor sizes, starter sizes, dimensional fit in spaces shown, equipment interfacing, conduit and conductor sizing, and interlock circuits. List each system and name of vendor for each system who was contacted for coordination.

L. General Contractor shall route all Vendor submittals with electrical requirements to Electrical Contractor who shall review and coordinate all power and control requirements and affix stamp certifying coordination. Any variation to plans or specifications shall be noted accordingly on Vendor's submittal.

M. All equipment shop drawings shall indicate changes or modifications as a result of previous submittal variances. No shop drawings shall be submitted that have not been coordinated as required by this specification. Any submittals not coordinated as such will be at Contractor's risk and at no additional cost to Owner for required changes necessary for a complete operating system as intended by the plans and specifications for this project.

N. Verify exact location of proposed service rack or pole before starting work. Verify coordination with Power Company and show location of Power Company transformer pole. Verify span length of service drop is within Power Company acceptable standard span distance. Do not drop over equipment, structures, driveways, or site.

O. Provide detailed sketch of all uni-strut racks and other type mounting assemblies for Engineer's review before starting work. Items not submitted and not determined as acceptable after construction shall be replaced at no additional cost to Owner.

P. Provide detailed drawings of equipment, transformers, and control panel layout in room or on area plan drawing. Show dimensions of device layouts on control panels. Show room or area dimensions, conduit stub-up locations, and all other dimensions relative to placement of equipment. All equipment shall fit available space shown on plans. Provide detailed drawings of any modifications, concrete cutting or breaking, or any work not shown on drawings for Engineer's approval. Non-submittal of any such work will result in corrective action at Contractor's expense. Special fabrication may be required for control panels and other equipment. Note any exceptions or variations on submittal. Do not order equipment or panels until submittal has been approved by Engineer in writing. Where outdoor light poles and pull boxes are installed, provide dimensioned location layout submittal before starting work.

Q. Where Equipment Manufacturers supply power and/or control cables, Contractor shall coordinate cable and conduit size and lengths. Failure to do so will be at Contractor's expense.

R. Wiring Diagram: Provide complete wiring diagrams and one-line diagrams for all control panels, controls sections, and related field wiring. Provide wire terminal and wiring tag numbers. Show all wiring as it will appear in final fabricated panels. Designate field wiring, local control panel wiring and show interface terminals. Field wiring shall not be connected directly to panel mounted devices. All connections shall be via an interface terminal strip. Show type of terminations. Forked lugs are not acceptable. Show one-line diagram for control panel.

S. Component Layout:

1. Provide layout of each component installed inside control panels and related back plates. Show designation of each component and provide identification legend for each one. Provide cross-referencing to applicable data sheet and Table of Contents. List exact model number of each item. Note any

substitutions. Show method of mounting. No components shall be located in panels that are not securely mounted.

2. Show method of covering or protecting live parts above 300 volts from accidental contact by service persons or operations. No adjustable devices that may normally be set by Operator shall be located near live parts over 300 volts without adequate protection.

T. PLC (Programmable Logic Controller) and OIU (Operator Interface Unit) Programming Software: Submittals for Equipment Vendor programmable controllers shall include two (2) copies of Manufacturer's licensed original programming software for Engineer and Owner use. Software shall be as specified or, shall be as specifically recommended by PLC Manufacturer, as approved by Engineer. OIU software shall be provided where applicable. Owner shall have new original copies of all software.

U. Operating System Software: Where HMI (Human Machine Interface) or PC (Personal Computer) applications are included in project; provide Owner original licensed copies of all software as noted in Specifications. Submit at time all other applicable equipment items are submitted.

V. PLC and other solid-state controllers furnished and programmed by a Manufacturer shall require submittal of addresses and OIU and HMI templates for programming purposes. There are no exceptions to this requirement, which shall be coordinated by the Contractor.

W. Provide schedule of all adjustable control devices and settings for proper and safe operation of equipment and motors, especially time delay settings.

1.6 OPERATION AND MAINTENANCE (O&M) MANUALS

A. The Contractor shall provide O&M Manuals in accordance with the requirements of Section 01730.

B. Drawings shall be in AutoCAD format or, may be PDF where AutoCAD is not available. Cut sheets shall be PDF. In addition to "as-built" system drawings, the manuals shall include internal wiring diagrams and operating and maintenance literature for all components provided under this section. The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, programming and configuration, adjustment, calibration, testing and maintenance of each component and/or instrument. Provide listing of all current control device settings, including operating levels and pressures, alarm settings, solid-state device settings, radio and modem addresses, PLC addresses, etc. Provide setting tables for all equipment. The O&M manual shall be professionally composed and compiled and shall not be an assembly of "cut-sheets". Engineer shall have sole discretion of acceptance of O&M manual contents and composition. Do not include Manufacturer's catalog data that does not apply to the specific equipment or devices used for this project. O&M Manual submittals will require a minimum of 2 weeks for review from time of receipt by Engineer. Contractor shall submit in time to account for this period of review.

C. The contents of the O&M manuals shall be generally organized as follows:

1. System Hardware/Installation
2. System Software (where applicable)
3. Operation (step-by-step procedures)
4. Electrical and Control Wiring Diagrams.
5. Maintenance and Troubleshooting
6. Warranty Certificates
7. Wiring Diagrams
8. Instrument and electronic devices calibration ranges and scales for this specific project. (Manufacturer's general information is not sufficient. Include range of 4-20 mA signals, i.e., 4 mA = X psi or Y feet, etc. for each specific instrument and device.)
9. Setting and adjustments of all solid-state and non-solid-state starters, circuit breakers, controllers and other equipment with adjustable settings both manual and programmable settings.

10. Statement of satisfactory demonstration of all instruments, devices and equipment functions over full range of operation. (Any failures or incorrect calibrations or settings detected shall be reason to halt demonstration tests and reschedule after adjustments and recalibrations have been completed.)
11. Factory Technician report stating that all calibrations, settings and adjustments have been completed and that equipment has been functionally tested by Factory Technician on site. (Where report is found to be inaccurate, the Technician shall make necessary on site adjustments and shall issue new report, and where second report is required a Factory Manager shall sign report attesting to its accuracy. There is no exception to this requirement. Contractor shall be responsible for all factory set up, testing and demonstration costs until system is accepted by the Owner. Any additional testing as result of non-acceptance by Owner and/or Engineer shall be at Contractor's expense.
12. As-Built Drawings (Point to point wiring diagrams for every electrical device installed on this project.

D. Where Electrical and Instrumentation Equipment is to be installed under this contract or where existing and noted, the Contractor shall further provide a complete set of as-built plans, diagrams, parts and materials list, parts source, operational instructions, programming data, maintenance and troubleshooting instructions, service data, calibration data, testing data, required service and programming instruments and wiring diagrams sufficient for complete operation, service and programming and maintenance of the Electrical and Instrumentation Equipment by operators or by outside service technicians. This information shall be provided on CD in AutoCAD 14, or later version for drawings, and in Word format and shall be arranged in final order for insertion into Electrical and Instrumentation Equipment files. Where AutoCAD drawings are not available, PDF files will be accepted. Coordinate overall layout and contents with Engineer. Allow adequate person-hours for adjustment of layout and contents during Electrical and Instrumentation Equipment testing and Owner review. All data submitted will be reviewed by Engineer for acceptance and where deemed insufficient by Engineer, data will be resubmitted at no additional cost to Owner.

E. As-Built Drawings: Provide As-Built Drawings that clearly shows 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. All changes are to be in AutoCAD or other applicable CAD methods. Contract Engineer for CAD standards to be followed. Submit As-Built Drawings on CD for approval.

1.7 CONTRACTOR QUALIFICATIONS

A. Contractor, Subcontractors, and Controls Vendors shall be experienced with all types of electrical systems covered under this contract. No work shall be undertaken where Contractor's firm, project supervisors and project electrical workers have not had recent experience in similar projects in area of project location. Contractor will be required to furnish proof of experience where requested by Owner or Engineer or their Representatives.

B. Contractor's Project Manager or his Assistant shall be familiar with types of electrical construction required by this project in order to determine that all subcontractor and vendor's work is in conformance with the plans and specifications.

C. Electrical Contractor shall have Master Electrician License for City or County; in which project is located, and shall have a State issued Master Electrician License.

D. Contractor shall have an established safety-training program in effect for the duration of this project and will be required to submit proof of safety training for all employees working on this project.

1.8 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall coordinate electrical power, telephone or special purpose line installation with utility companies. Within 30 days after award of contract, the Contractor shall contact utility company and Owner and shall request service needed. It is Contractor's sole responsibility to assure that utility company and Owner are

notified and are kept aware of requirements. Advise Owner of exact voltage and phase service required when completing application for service.

B. Owner and Engineer shall be advised in writing of Utility Company Service Representative handling service order, telephone number, address and order number within 30 days of Contract Award and notice to proceed. Contractor shall notify Engineer and Owner of proposed service poles to be installed by Power Company and Contractor and shall include copy of "Outlet Location Data Statement" from Power Company before installing poles or conduits. Delays in services installed due to failure to make timely application shall be at Contractor's expense. Refer to requirements of Section 16401, Electrical Service, and comply with all conditions before starting construction. Work shall not start on service equipment or feeder until "Outlet Location Data Statement" is received from Power Company and approved by Engineer. Contractor shall provide data sheets to Power Company for transfer switch to be installed (where shown on Plans.)

C. Contractor shall provide all conduit, conductors, and termination equipment as needed for utilities and shall coordinate with utility companies for installation requirements and shall provide installation constructed according to the utility company standards whether or not such is shown in detail or plans. Where underground service is provided by Utility Company, the Contractor shall provide service installation accordingly and shall allow for up to 100 feet of underground feeder ductbank. Work shall include all equipment and materials required for working service.

D. Contractor shall review all sections of the plans and specifications for this project and shall note all electrical requirements for devices and equipment shown or implied, and shall provide service accordingly for a complete operating control system. Any discrepancies in Electrical or Mechanical requirements noted in various plans and specifications shall be brought to the attention of the Engineer prior to ordering equipment or materials or prior to starting construction related to the item in question. Coordination of all equipment and systems is Contractor's sole responsibility. Failure to coordinate all equipment requirements shall be the responsibility of the Contractor, at no additional cost to Owner.

E. Contractor is specifically responsible for coordination of all electrical, mechanical, and process systems, devices and equipment provided or installed under this contract and shall assure that all requirements by all trades are met such as to insure a complete and operating electrical, control, process or instrumentation system. Special attention shall be given to coordination of motors supplied, mechanical systems supplied, horsepower and voltage and phase requirements of each. Where motor horsepower varies from plans, Contractor shall adjust circuit and control devices accordingly. This includes verification of compatibility of all interfacing connectors and devices at new, existing, and Owner furnished equipment. Notify Engineer of any discrepancies before ordering equipment. Failure to do so may result in additional cost to Contractor.

F. Contractor shall assure that all systems have been properly installed, adjusted and tested prior to final inspection and shall notify Engineer at time electrical installation is ready for final inspection and testing. Unless Engineer has been duly notified in writing that certain equipment is not ready for final testing and such is acceptable with Engineer, additional final inspections and testing will be at Contractor's expense and at no additional cost to Owner.

G. Contractor shall fully inspect all motors and nameplates, controls, conduit, wiring devices and other items before starting work, ordering materials, or submitting shop drawings in order to verify existing conditions are as shown on plans and, shall immediately notify Engineer of any discrepancies between plans and specifications and existing conditions. Failure to do so may result in Contractor's responsibility for any required changes in construction. This includes verification of compatibility of all interfacing connectors and devices for new, existing, and Owner or Contractor furnished equipment. Notify Engineer of any discrepancies before ordering equipment. Where available review "As-Built" drawings before bidding where existing conditions are unknown. Where available refer to "As-Built" drawings during construction of this project. Note that "As-Built" drawings may not be available in which case Contractor is required to determine wiring connections and device types as part of this contract. Where Manufacturer's delivered motor size varies from design size shown on one-line diagram or, described in specifications, Contractor shall provide conductors, conduits, and all motor control devices sized for the

delivered motor size at no additional cost to Owner. Where motor current transducers are required for use by Manufacturer control panels, Contractor to provide current transducers and conductors sized by Control Panel Manufacturer at no additional cost to Owner.

H. At completion of project and before final inspection, Contractor shall provide the Engineer with full size prints, redlined to reflect the "As-Built" electrical installation. Any variation from plans shall be shown on each applicable plan sheet. In addition, provide completed As-Built drawings in AutoCAD format for Engineer's records. As-Built drawings are to be in accurate detail of finished work.

I. When work involving modifications or additions to existing facility will interrupt normal service, Contractor shall make provisions for continuous electrical service thru Contractor furnished standby generator power. Where a standby generator exists but will be temporarily out of service during construction, Contractor shall provide substitute generator power for duration of outage. In no event shall facility be without operating power or, without standby generator service. Include all transfer switches, fuel tank, fuel, attendance and appurtenances required for a complete power system as needed for interim operation.

J. Where work disrupts power and/or control to new or existing equipment, furnish temporary bypass circuits, as required, to maintain equipment operation.

K. Where work involves additions, modification, demolition, or renovations to existing facilities, Contractor shall remove, relocate, and extend existing installations to accommodate new construction. This includes relocation of conduits, equipment and materials that may obstruct placement of new equipment. Existing spare conduits and equipment may not be located at exact place shown on plans. Relocations and adjustments up to 20 feet are required as part of this contract. Where spare buried conduits are to be reused, conduits shall be cleaned out of all debris before use. It further includes extension or modification of existing circuits that are related to work covered under this project. Route all existing alarms to autodialer, alarm panel, and PLC where available. Include all conduit and wiring. Extend all existing power and control circuits as required for proper operation of electrical systems. Contractor shall field observe existing conditions prior to submitting a bid to become familiar with existing conditions and shall account for any relocations or extensions in bid. Refer to "As-Built" drawings and existing O&M Manuals. Failure to do so is at Contractors' risk and at no additional cost to Owner.

L. Provide electrical circuits to all equipment as required by manufacturer. Verify location and characteristics of all equipment shown on plans and in specifications and size circuits accordingly. All conductors and conduits to comply with NEC Article 250 and Article 310. All terminations to vendor furnished control panels shall be done by Contractor, unless specifically noted otherwise on plans or in specific specification sections. All panel calibrations and adjustments shall be done by Vendors Representative. When preparing bid or when performing work, observe all plan sheets for vendor furnished equipment and provide all required interface wiring between various panels and/or equipment necessary for a complete operating system. Provide electrical circuits to all equipment, devices, controls, controllers, and other items shown on plans, or described in specifications. Provide circuit breaker, conductor, local disconnects, and connections to equipment in compliance with National Electrical Code. All circuits may not be shown on plans and must be verified and installed accordingly.

M. Equipment, instruments, controllers, VFD's, conduits, and related appurtenances are shown in approximate locations. Contractor shall field select optimum location and where necessary, relocate up to 40 feet from location shown on plans to accommodate installation, at no additional cost to Owner.

N. Where circuit problems such as irregular power conditions, breaker trips, relay trips, controls failure, etc. develop during construction or prior to or within the warranty period, Contractor shall furnish a multi-channel recording device with all appurtenances for a total period of 60 days per event and, shall include setup and data retrieval. Work shall be performed when requested by Engineer and shall be at no additional cost to Owner. These conditions also apply to electrical problems during construction where operations of the facility are affected.

O. Where any equipment performance does not conform to specifications or, where in Engineer's opinion, parameters are out of tolerance or erratic in performance, the Contractor shall remove and replace equipment at no additional cost to Owner.

P. Location of outlets and equipment shown on Drawings is approximate. Field verify exact location. Minor modification in location of outlets and equipment is considered incidental up to distance of 40 feet with no additional compensation.

Q. Where training is required by any specification sections, Contractor shall provide training manuals for Operators. Manuals shall be approved as substantial quality by Engineer. All training manuals must be pre-approved by Engineer. Instructors shall be pre-approved by Engineer as qualified for training. Provide a training manual for each Trainee attending class. Training manuals and approved O&M Manuals shall be used during training.

R. Provide fail and problem alarms for controls and Manufacturer's equipment. Route circuits to autodialer. Provide circuits, relays, expansion modules, and programming. Route all existing alarms to autodialer where work involves modification or additions to existing equipment.

S. 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 lines is the sole responsibility of the Contractor and shall be at no additional cost to Owner. Any damage to underground lines is the responsibility of the Contractor. Where obstructions are present in existing spare U.G. conduits to be used in this project, use video camera to determine cause of obstruction and contact Engineer for directions on how to proceed.

T. Review all plans prior to bidding and during construction and provide power and control requirements for all valve actuators and Manufacturer furnished panels according to the Engineer's specifications and plans for all equipment. This further includes all starters, breakers, controls, conductors, conduits, interface wiring, and devices for a complete electrical system.

U. Refer to contract plans and provide local disconnect switches for all motors, heaters, fans and electrical equipment required for this project per National Electric Code. (Applicable where shown on plans.)

V. Change orders submitted by Contractor shall include a full technical explanation of request and shall contain statement confirming that Contractor has reviewed all plans and specifications and that all work was coordinated with other trades.

W. All equipment, devices and other items shown or indicated on plans and described in specifications are to be provided, furnished and installed by the Contractor unless, specifically and clearly marked or noted as "N.I.C." (Not in Contract). Failure to include all items is at Contractor's expense and at no additional cost to Owner.

X. Contractor shall be responsible for maintaining and adjusting all equipment for safe, damage free operation where equipment must be operated by Owner during construction. This especially pertains to existing equipment and controls that may be modified under this contract but are required to be operated by Owner. All valves, motors, and controls shall be properly locked out in a safe position to prevent inadvertent damage by Owner during the course of operating the facility. Contractor shall notify Owner in writing of any equipment that cannot be safely operated.

Y. Programmable Logic Controller (PLC) and Human Machine Interface (HMI) hardware, HMI templates, address, tags, and software are to be provided by Vendors and Contractor. All drivers and related software purchased by Contractor shall be compatible versions to allow satisfactory interface of systems. Contractor shall have statement from Vendors that all drivers are proper type for this application.

Z. Where telephone, data line, communication line or other means of communications between control system components is provided, Contractor shall be responsible for coordination of hardware and software to assure compatibility for satisfactory communications and accurate transfer of data is accomplished.

AA. All requirements for instrumentation and control equipment shall be reviewed by Manufacturer's Representative prior to shop drawing submittal and, Engineer shall be notified in writing when installation and application indicated on plans may not result in satisfactory and/or accurate operation of equipment specified. Failure to abide by this requirement is at Contractor's risk and expense.

BB. Provide FAA approved obstruction lighting on all towers and structures where required by FAA Standards by location. Provide circuits from nearest 120-volt panel.

CC. Motors:

1. Motor Voltage: All three phase motors to be wound for dual voltage 240/480 or 208/480. Single phase motors to be 120/240 or 120/208 volts. This includes all submersible motors.
2. Testing:
   a. Before connecting motor to power source, meg test each conductor and motor. Record results for Engineer's review.
   b. After energizing motor, measure load current of each phase leg. Record measurements for Engineer's review.
   c. Verify measurements are acceptable before energizing motor.

DD. Provide reactors and/or filters as required to prevent any harmonics or disturbance from VFD's or other devices on the power system. Any interference to other instruments or equipment shall be resolved to satisfaction of Engineer. Use only VFD rated cables from VFD to motor. All VFD cables to be installed in steel conduit only.

EE. All signals up to point of PLC terminals shall be tested by Contractor and acknowledged in writing to Engineer prior to installation or testing of programs.

FF. All conduits stubbed out for future use shall be routed clear of all paving, structures, sidewalks, or any other obstruction that may limit future access for connection to conduits. Stub out minimum 5 feet clear and cap end of conduit. Do not apply adhesive or cement to PVC caps at end of conduit. Install marker at end of conduit.

GG. All underground conduit routing on site plan shall be followed as close as practical. Do not route conduits diagonally across property unless clearly shown as such or, with Engineer's written approval. Any conduits added or changed shall be indicated to Engineer on marked up drawing and submitted for approval. Any unauthorized changes shall be corrected at Contractor's expense, regardless of time discovered by Engineer and, in which case existing concrete shall not be cut or damaged but, shall be replaced in its entirety as shown on the plans as new construction. Do not route underground conduits in conflict with structures or obstructions. Allow in bid for relocation of underground conduits up to 20 feet to avoid obstructions shown on all other drawings issued under this contract. Coordinate prior to installation of conduits.

HH. Cabinet and Enclosures Heights: Cabinet, panel and enclosure fasteners heights shall not exceed 6 feet from floor or grade to top fastening devices to allow access by Operator without use of ladders or steps to open enclosure doors. Refer to paragraph entitled Materials of this specification for display screen and readout heights.

II. Provide diagrams of all controls panels in clear plastic laminated pages. One (1) copy in ring binder for Operator and one (1) copy in pocket affixed to inside of cabinet door.

JJ. A state licensed Electrician shall be present at all scheduled inspections. No Exceptions.

KK. Contractor shall contact the local Factory Representative and verify all equipment, instruments, and devices provided conform to the requirements of this project. Failure to do so may result in equipment removal and

replacement at Contractor's expense. Refer to paragraph entitled Submittals of this specification section for submittal information.

LL. Provide all required wire adapters for oversized feeder conductors at panels, switches, breakers, and other equipment.

MM. Where outdoor conduit top entry to enclosures, provide CSBE seals at top of conduits to avoid water entry. This applies to service bus weatherhead entries and other applications.

NN. Alarm reporting devices such as automatic telephone dialers shall never be disabled once installed and put in operation or, where already installed at existing facilities. Test autodialer at end of each workday during construction period.

OO. Methods of work and devices described in all electrical specification sections are intended to facilitate a properly constructed and operating electrical system that meets Owner's operational requirements and satisfies the requirements of local and national codes. The Engineer may approve methods or devices that vary from the requirements described in any particular specification if, in the Engineer's judgment, the installation meets the intent of the Engineer's design and, where the electrical system performance meets the general requirements of the facility operation and, where the installation is deemed to present a safe installation that does not present a danger to persons operating or maintaining the electrical installation. This variance may be authorized during the submittal or inspection stage of the project, as the Engineer deems appropriate.

PP. All equipment, conduits, panels, and devices shall be installed in the most strict, professional manner to present a neat installation. Where a question arises concerning intent of method for installation or where details are not clear, Contractor is to contact Engineer for clarification before proceeding with work. Any work not suitable or not installed in a professional manner will be modified to an installation acceptable to Engineer and Owner at no additional cost.

QQ. Provide arc flash warning tags on all electrical equipment where required by NFPA 70E. Submit arc flash analysis for Engineer's review.

RR. All motors and all other electrical equipment shall be stored in a climate-controlled area prior to installation. Space heaters in motors and equipment shall be energized while stored. After installation space heaters shall be energized at all times. See Section 16150, Electric Motors, for additional requirements. Contractor is liable for any corrosive damage and any defective equipment.

SS. All control panels, and equipment shall be fabricated to fit available space shown on plans. This includes Code clearances.

TT. Any equipment, devices, or software shown or indicated on Contract Documents as required for this project, and that may be overlooked by Owner or Engineer on submittals or at Final Acceptance inspection, shall still be provided by Contractor at no cost to Owner regardless of period of time that expires before Owner requests to be furnished and installed.

UU. Do not cut or break existing or new concrete foundations, pads, sidewalks or slabs without specific direction from Engineer. Submit detailed drawing of intended work concrete damage, breaking or cutting will result in entire concrete replacement at Contractor's expense. This includes any materials replacement and excavation resulting from said damage or work.

VV. Vendors for equipment with solid-state controller shall include provisions for both hardwired and data path status, command and alarm functions included under contract without additional cost to Owner or Engineer.

WW. All generator connections to be wired in same manner, and in A-B-C orientation, to facilitate pump rotation in correct direction.

XX. Construct electrical instructions and control panels to fit space shown on plans. Allow for NEC clearances.

PART 2 - P R O D U C T S

2.1 MATERIALS

A. All materials provided under all sections of the specifications shall be new and the standard products of manufacturers regularly engaged in the production of such equipment. Motor control centers, control panels, controller panels, pump panels, blower panels, and all similar equipment shall be manufactured by a firm located within 200 miles of the project facility or, firm shall have an established full time service and repair facility located within 200 miles of project facility. Final assembly of motor control centers and control panels shall be performed at these local facilities. All materials shall conform to the National Electrical Code and shall be approved by Engineer and listed by the Underwriters' Laboratories. Materials described by manufacturer's name and catalog number are selected to set a definite standard of design and quality to be required. There is not any intention to discriminate against a product of another manufacturer, which is equally durable in construction, similar in design, and will serve the purpose for which it is intended.

B. All equipment, hardware, materials, motors, towers, masts, brackets, or accessories shall be installed in strict accordance with Manufacturer's instructions. Contractor shall contact Manufacturer's designated local Representative for confirmation of exact model, options, configuration and services that are to be included in bid cost. Manufacturer's Representative shall make all critical adjustments to electronic modules and controls. Where plans, details, or specifications indicate instructions that are contrary to Manufacturer's instructions, consult with Engineer before ordering or installing. Failure to follow the requirements of this paragraph is at Contractor's expense and at no additional cost to Owner. Within 30 days after award of the contract and before any materials and equipment are placed on order, the Contractor shall submit shop drawings to the Engineer for approval per paragraph entitled Submittals of this specification.

C. Materials and equipment specifications are general in coverage and may contain reference to construction items that apply in only particular situations and may not apply as a general rule for materials installed on this project. Provide all required accessories required by Equipment or Materials Manufacturer for proper installation. Failure to do so is at Contractor's expense. Store all electrical equipment on job site in humidity-controlled spaces. Provide means of heating to avoid moisture build-up, and provide moisture sealed protective covering. Any equipment not properly stored may be rejected at Engineers discretion.

D. All equipment and devices shall be installed according to manufacturer's instructions. Coordinate installation with manufacturer's representative to assure correct installation methods have been applied. Prior to submittal review, Manufacturer's Representative shall review plans and specifications and shall notify Engineer in writing where application shown on plans will not provide satisfactory and/or accurate performance. Failure to abide by this requirement shall be at Contractor's risk and cost. All equipment and materials shall be rated for the harsh marine Industrial, Electrical, and Mechanical environment in which installed and shall be warranted by manufacturer accordingly. This includes all enclosures located in wastewater facilities, including all outdoor control panels, breaker panels, switches, junction boxes, and similar electrical equipment at other facilities, which shall be NEMA 4X or 6P stainless steel, as denoted on the drawings. This requirement is paramount to all other drawings or specification requirements unless specifically noted or, unless approved otherwise by Engineer in writing.

E. Outdoor equipment shall not have exposed devices or controls, unless specifically called for on plans. The outer door shall cover all such items. No see thru windows are allowed unless specifically approved. All outer doors to have locking hasp and door restraint to hold door open at 90 degrees position. Keyed handles for indoor panels are only acceptable where specifically approved. All NEMA 4X equipment enclosure doors to have three (3) point latching handle and locking hasp. NEMA 4X splice box enclosures shall have quick release latches. Plexiglas inner or outer doors are not acceptable. All NEMA 6P enclosures shall have a NEMA 4X interior; refer to Section 16135, Cabinets, Boxes and Fittings, for additional requirements.

F. All PLC's, controllers, VFD's, instruments and electronic equipment installed outdoors or in unconditioned spaces shall have means of cooling to allow satisfactory operation in local environment and at conditions required by equipment manufacturer's specification. All motor starters over 100 horsepower shall have forced fan cooling in the starter section. All outdoor enclosures are to have sufficient forced fan cooling. Provide rain hood, intake louvers, insect screens, and fan motor circuits with t-stat and on/off controls.

G. All control panels and motor control centers that are not standard manufacture, off the shelf products shall be manufactured in accordance with Plans and Specifications with high quality materials and components, bear a UL listed label, and be constructed by a UL listed shop. Manufacturers, if specified herein, who fabricate own panels may provide control panels for this project; however, all panel manufacturers must utilize the pump controller manufactured by Best Controls Company, as indicated in the technical specification and as shown on the drawings. In addition, Manufacturer shall have local manufacturing and/or repair facility within 200 miles, and shall have local Service Technician capable of providing prompt service when required by Owner. Service Technician shall have detailed knowledge of control panels specific to this project. There are no exceptions to the requirements of this paragraph. The following Manufacturers are acceptable:

1. K2 Services, LLC (using pump controller manufactured by Best Controls Company).
2. Five Star Electric (using pump controller manufactured by Best Controls Company).
3. Mercer Controls, Inc. (using pump controller manufactured by Best Controls Company).
4. Pre-approved substitution (in writing prior to bid date).

H. Substitution items may be acceptable where deemed by Engineer to be of equal type, service, value, or suitable for a particular application. The Engineer reserves the right of decision on all substitutions unless specifications state, "no substitutions allowed".

I. Equipment ratings shown on plans are the "minimum" acceptable sizes. All Equipment Manufacturer's products may not be available in the exact rating shown, in which case next greater available size shall be provided.

J. Generator connectors installed at transfer switches shall be lug-type wired connections. Contractor shall coordinate connector's wiring with Owner's existing generators to assure compatibility.

K. All control panels shall have single piece door with door-mounted devices mounted directly to door. Plexiglas plates are not acceptable. Auxiliary mounting plates shall not be used to mount devices to door. All panels must be fabricated in a neat and professional manner. Metalwork shall be performed with proper commercially available tools, with no hacksaw or nibbler cuts allowed.

L. All transmitter displays to be in actual unit values and not percent scale.

M. Door-mounted, rotating operating mechanisms for circuit breakers are not allowed for or control panels.

N. All components inside enclosures shall be fastened down with proper hardware. All cables shall be bundled and bound with waxed cord or nylon tie-wraps manufactured for that purpose. Adhesive tie down blocks are not allowed. Provide threaded press-in or welded studs for nylon cable clamps as required. All work shall be done in a neat and professional manner.

O. All control panels shall have 120 VAC GFI duplex receptacles with low voltage circuit inside controls section for test equipment use. Control section shall have interior lighting.

P. For combination starter units provide interlocks so disconnect means must be in "Off" position before door can be opened and so door cannot be closed with disconnect means in "On" position, except by consciously operating permissive release device. Rotating type operators located outside of door are not acceptable.

Q. All gauges, instruments, transmitters, and meters to read 75% of scale at system maximum rated parameters such as voltage, amp, pressure, level, and flow.

R. All controls circuits for PLC's, VFD's, solid state starters, power monitors and all such products wired into a panel assembled by a panel fabricating shop or system integration shop shall be reviewed and approved by the Product Manufacturer's Representative. Contractor and Supplier shall allow for any additional cost associated with this review and approval process and shall certify such approval has been issued at time shop drawings are submitted.

S. Submersible pump power cables shall be a single cable assembly. Multiple cables with parallel conductors less than size 1/0 are not acceptable unless approved in writing by Engineer. Where multiple power and/or control cables are approved for use, Contractor shall provide all required conduit, conductors and junction boxes at no additional cost to Owner.

T. CT's for power monitor device, controller input or other instrument inputs shall be sized to detect peak inrush current motor.

U. 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. Do not route unprotected (overcurrent) service conductors through pull boxes, per Power Company standards.

V. All panels, equipment enclosures, and motor control centers to have 120-volt space heater and t-stat.

W. All solid state controllers shall have 24-hour UPS to power PLC, I/O modules, and output relays.

X. All electrical devices attached to or, normally a standard part of an equipment item shall be provided by that Equipment Manufacturer. For example, limit switches, solenoids, and transducers for flow control valves are to be provided by the Flow Control Valve Manufacturer. This is to be coordinated by the General Contractor and the Electrical Subcontractor.

Y. All underground manholes and pull boxes to have cable racks and grounding. Cables and conductors are to be neatly dressed on racks around perimeter walls and properly secured to racks and tagged. Provide ample slack in cables and conductors. No splicing will be allowed where there is not enough slack to route cables and conductors around perimeter and, new ones will be installed at no additional cost to Owner.

Z. All equipment installed on this project shall incorporate all devices and features to protect that equipment from the influence of other equipment, line voltage and phase irregularities, harmonics and other disturbances that may affect the proper and safe operation of that equipment whether these required features are a standard component of that equipment as an off-the-line product. No equipment shall be installed without these features.

AA. All submersible pump over-temperature and seal leak modules shall have latching circuit with reset and alarm indicator light built-in or provided as external circuitry.

BB. Use Schedule 80 PVC conduits, boxes and fittings in all chemical areas. Provide seals where conduits leave area.

CC. All equipment installed shall include all DC power supplies operated from a 120-volt circuit. No equipment shall be battery powered only unless required by the specifications. Include all cabling and other components necessary for a complete operating system. Where firmware, software, or programming is required for operation satisfactory to Engineer, it shall be included accordingly.

DD. All equipment and devices shall be NEMA rated. IEC rated equipment and devices are not acceptable.

EE. All requirements for instruments, VFD's, and electrical equipment shown on electrical plans or described in electrical specifications shall be coordinated through the local Manufacturer's Representative to assure equipment meets the requirements for this project. All such items shall be purchased through local Distributors or sales offices located within 200 miles of this project. In any case, the local Factory Representative shall be consulted for exact

requirements – no exceptions. This is to assure local service for Owner when needed on a 24-hour basis. Any items furnished that do not meet this requirement will be replaced at expense of Contractor.

FF. All indoor surface mounted circuit breaker panels to be NEMA 12 with stainless steel housing, unless shown otherwise on plans. Use NEMA 4X stainless steel enclosures in sludge facility buildings and all outdoor locations, except where NEMA 6P enclosures are shown on drawings.

GG. All electrical work shall be performed in a neat and orderly manner. Any work that does not appear as professional workmanship shall be corrected or replaced, at Engineers discretion.

HH. All slabs around electrical equipment shall be constructed and sloped to avoid any standing water.

II. Where equipment model numbers are shown on plans or specifications, provide most current model or version.

JJ. All display screens or readouts shall be mounted in panel with top of screen at height of 60 inches above or level where Operator stands. This must be accounted for where panels are installed on concrete pads or other elevated structures. Display screens or readouts shall not be lower than 40 inches above level where Operator stands.

KK. Measure spaces for enclosures and equipment and verify fit before submitting, ordering, or constructing installation.

LL. Where devices with RS-485 outputs are installed, provide an RS-485 to Ethernet converter with associated power supply.

MM. For rehab or expansion work on controls, provide additional new panduit wireways. Do not overfill Panduit on new or rehab projects.

NN. All electronic controllers, instruments, and devices furnished by any Vendor or Manufacturer shall have an ethernet data port and means for status monitoring and control interface with the Owner's primary PLC controller. Vendor to provide all programs, software, and I/O addresses.

OO. Install GFI receptacles for receptacles in wet areas, pump rooms and all outdoor locations. Provide W.P. covers.

PP. All service and feeder breakers to have removable adjustable trip plug or be electronic type with adjustable trips.

QQ. All service and feeder conductors to be XHHW-2.

RR. All analog instrument outputs to be 4-20 mA unless noted otherwise on Plans. Coordinate scaling with Engineer.

2.2 PLANS AND SPECIFICATIONS

A. Electrical plans and specifications are not intended to discriminate against any particular manufacturer. Specific values shown for a particular manufacturer's product may vary slightly for another product. Work required under this contract consists of each and every item, equipment, material and device shown on any of the Civil, Structural, Mechanical, Process, Electrical or other plan sheets contained in the contract documents and includes items shown in details, schedules, diagrams, sections or other means of illustration presented. If any item is shown on a single sheet at any place, it is to be included under this contract unless specifically noted otherwise and, all piping, wiring, and connections for operation of the item shall be included at no additional cost to Owner. If there is any doubt or question, Contractor shall request a "clarification" from Engineer before bidding. The Engineer

reserves the right to interpret the electrical specifications and to make judgment as to acceptance of a product, regardless of minute details in the specifications or on the plans.

B. Specifications shall be reviewed for applicability of materials under certain conditions and in certain environments and, where not shown otherwise on plan drawings, these application directions shall be adhered to.

C. Where a particular reference on drawing plans does not conform to standard acceptable construction methods for a particular type project, the Contractor shall immediately notify the Engineer and request a clarification before ordering materials or starting construction.

D. Plans are general in nature and may not show minute details of existing conditions or proposed work. Existing conditions may include undocumented buried pipes, conduits and structures that lie in the route, or at location, of equipment or conduit installation required for this project. These uncertainties shall be accounted for in the Contractors Bid. Contractor shall adjust conduit routes, equipment pads, and equipment mountings, as required, for a satisfactory installation for the conditions imposed and at no additional cost to the Owner.

E. Electrical site plan drawings shall only be scaled when "Scalable Drawing" appears on the drawing sheets.

F. All electrical equipment, controls, and devices used in this project shall have self-protection features that prevent damage of that equipment from overload, overvoltage, and undervoltage conditions. Any failures caused by lack of this provision shall be at full cost to Contractor and at no additional cost to Owner. Where Engineer determines this to be the case and where Contractor disagrees, Contractor shall provide full evidence of failure cause at their own expense.

G. All overcurrent protection devices for controls shall be circuit breakers. No fuses of any size are allowed.

2.3 SPARE PARTS

Provide the following spare parts for all equipment provided on this project: twenty (20) each spare indicator lamps of each type for all equipment covered under this project.

PART 3 - E X E C U T I O N

3.1 WORKMANSHIP

A. All wiring shall be installed in accordance with current NEC and local codes. Field select routing of conduits to avoid underground piping, conduit or structures that may not be shown on plans.

B. All construction and equipment fabrication shall be of highest quality and installed in a professional manner. All devices shall be manufactured specifically for the purpose installed and shall be installed according to Manufacturer’s recommendations.

C. Adjust route of electrical conduits and ductbanks below proposed or existing buried piping. Provide minimum 24-inch clearance vertically and horizontally. This work shall be performed in a satisfactory manner and at no additional cost to Owner.

D. A fish wire shall be left in all conduits in which the permanent wiring is not installed.

E. All fixtures, switch, and receptacle locations shall be approved by Engineer.

F. Refer to other sections of this specification for controls. Under this section of the specifications, the Contractor shall install the control devices and provide control wiring switches, outlet boxes, and shall make all final

connections. Control wiring and interlocks shall conform to wiring diagrams furnished by equipment manufacturers.

G. Seal all conduits entering control panels and equipment enclosures with non-hardening silicon sealant (GE RTV.). Install EYS conduit bodies on all conduits entering chemical rooms. Seal with non-hardening silicon sealant (GE RTV). Seal all conduits entering control panels, and junction boxes with CSBE seals. Sealing glands shall be selected specifically for each conduit and conductor.

H. 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.

I. Provide strain relief device at cable connection to submersible transducer. Relief device to have threaded connection to transducer.

J. Where electrical equipment submitted does not fit location shown on plans, Contractor shall adjust locations of other equipment as required for total installation to fit available space. Otherwise, submit only equipment that is specifically fabricated to fit space shown on plans.

K. All devices, fittings, connectors, supports, brackets, and miscellaneous hardware normally used for installation of electrical equipment may not be shown in detail. Contractor shall provide all these items and included them in bid price.

L. Coordinate location of motor terminal box to match location of conduit stub up, drop or connection on same side of motor.

M. Where equipment, devices, or installation fails or is damaged during construction said equipment and/or devices shall be replaced with new unit. Repair is not an acceptable remedy unless specifically approved by Engineer and/or Owner.

N. Provide 48 inches minimum workspace in front of electrical equipment.

3.2 AS-BUILT ELECTRICAL DRAWINGS

Contractor shall maintain complete set of original legibly marked up drawings showing all deviations from contract drawings. In addition, after mark-ups have been approved, provide one (1) set of AutoCAD as-built drawings on CD for Engineer's records. This shall include conduit routing and sizes, wire sizes, detail changes, diagram changes, etc. As built drawings are to be maintained on site during construction and changes shall be marked as work progresses. Markup shall be in red pencil on black line or blue line plan sheets. Plans shall be available for Engineer and/or Owner's review during the course of construction. When work is complete, transfer all changes and data from field drawings to mylar drawings in latest release AutoCAD format. Contact Engineer for base AutoCAD files. Follow layering and other format already being used for base files. Include requirements of the following paragraph on an additional drawing sheet. As-built drawings shall contain a conduit/conductor schedule that lists all point-to-point wiring that shows origination, destination, conductor quantity and size, and each wire tag number. This list shall include all wiring not specifically shown in O&M manuals, or any Vendor supplied drawings. The intent is to make certain each and every conductor is identified. Coordinate identification of originating terminals and destination terminals shown in O&M manuals and other drawings to assure accuracy. As-built drawings will be required for use during final inspection and testing in order to verify accuracy and completeness. Provide for Engineer's review at least 1 week prior to final inspection.

3.3 ELECTRICAL SYSTEM ACCEPTANCE

System acceptance upon Substantial Completion shall be defined as that point in time when the following requirements have been fulfilled:

A. When as-built drawings and wiring diagrams have been submitted, reviewed, and approved in writing by Engineer. As-built drawings shall be submitted prior to final inspection.

B. All O&M documentation has been submitted, reviewed, and approved.

C. The complete electrical system has been fully inspected and has successfully been started up, tested and accepted by the Engineer.

1. Complete electrical system shall be demonstrated to be fully functional. Every alarm function shall be exercised.
2. Complete electrical system shall run continuously for a period of 30 consecutive days without failure. In event of failure, repairs shall be made and test period started over again.
3. There are no "Substantial Completions" for electrical systems that cannot demonstrate satisfactory performance of its intended function.

D. All Owners' staff personnel training programs have been completed.

E. Owner/Engineer sign a document indicating electrical installation has formally been accepted.

F. Warranty certificates for electrical equipment have been properly submitted.

G. All spare parts have been delivered to Owner.

H. All punch list items have been corrected, acknowledged by Contractor in writing and accepted by the Owner.

3.4 EXCAVATION AND BACKFILL

A. All underground conduits shall be buried to a minimum depth of 24-inches below finished grade. All trenches shall be uniform width and shall be backfilled and compacted to 95 percent that of original density. Any damage to underground conduits caused by other Contractor's shall be repaired by this Contractor and shall be compensated accordingly by the party or parties responsible for the damage. Concrete shall be poured evenly on all sides of ductbanks. Do not over pour and do not dump spoils on site.

B. Do not cut paved driveways, sidewalks, etc. Bore under such construction, maintaining a minimum of 24 inches below the underside of the pavement or concrete.

C. All underground duct banks require inspection prior to concrete pour and inspection prior to covering the concrete. Contact the Inspector, or if not available, contact the Engineer for inspections. Schedule minimum 48 hours in advance. Any duct banks not inspected will be required to be exposed for inspection by Engineer regardless of status of concrete slabs or foundations.

3.5 CLEAN UP

A. The Contractor shall upon completion of the work, remove all materials, empty containers, and any other materials that are not incorporated into the work.

B. Concrete spokes shall not be dumped on site without approval by Engineer or Owner.

3.6 WARRANTY

A. Electrical equipment shall be warranted in accordance with the requirements of Section 01010. Contractor shall provide full 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. Included under this warranty shall be all equipment, devices, hardware, and software.

B. All materials and equipment installed shall have full warranty from manufacturer that guarantees equipment is rated for the harsh marine Electrical/Mechanical environment in which it is installed. Where manufacturer's products fail prematurely, manufacturer shall be fully responsible for new replacement and shall not have option of declaring that failures were caused by environment and its affect on the product. Contractor is fully responsible for assuring that product manufacturers are aware of this condition and that warranty statement is included in shop drawings. Failure to do so will be at full expense of Contractor and at no additional cost to Owner. Where warranty requirements are shown in other sections, the more stringent requirement shall have precedence.

C. 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 five (5) working days from date of notice are subject to Owner making other arrangements for repair and backcharging Contractor. This requirement is a condition of this contract.

D. 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.

3.7 TRAINING

A. The Contractor shall provide services of his Technician and a factory trained Technician to instruct operating personnel for a period of at least two (2) full days after completion of the contract work. Training requirements in specific specification sections shall have precedence over requirements of this section.

B. Provide Engineer with an outline of training course and topics to be covered.

C. Schedule with Owner two (2) weeks in advance. Where Operators must alternate training schedule, more than two (2) days may be required.

D. Operations and Maintenance (O&M) manuals and "As-Built" drawings shall be used during training.

E. Engineer may participate in training.

3.8 TESTING AND STARTUP

A. All elements of each electrical control system shall be set up, calibrated, and tested by Manufacturer's Technician to demonstrate that the total system satisfies all of the requirements of this Specification. All special testing of materials and equipment shall be provided by the Contractor. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner and Engineer. As a minimum, the testing shall include both a factory test and a field test. Testing requirements are as follows:

B. 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.

C. Field Tests:

1. All electrical control system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly.

2. Witnessed field tests shall be performed on the complete system. Prior to witnessed test, Contractor shall perform a complete test of each and every function, device operation and overall operations of electrical power, control, and instrumentation. Any discrepancies or problems shall be corrected and then Contractor shall send a written notice that complete electrical system is installed and operating per the Plans and Specifications. This notice shall be signed by an Officer of the General Contractor's company. 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 paragraph-by-paragraph basis.

3. Any equipment, devices or functions that are found not performing properly will be reason for termination of test until repairs are made. Additional testing by Owner will be at Contractor's expense for time and travel of Engineer and Owner's staff. Each test shall be witnessed and signed off by the Contractor and Owner's Representative upon satisfactory completion. The Manufacturer's Representative shall be present for all testing, setup, demonstrations, and training. The Contractor shall notify the Owner at least two (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 90 days without failure. Any failures shall be repaired and test shall start over again.

a. Additional Requirements:

1) Instrument and electronic devices calibration ranges and scales for this specific project. (Manufacturer's general information is not sufficient. Include range of 4-20 mA signals, i.e., 4 mA = X psi or Y feet, etc. for each specific instrument and device.)

2) Setting and adjustments of all solid-state and non-solid-state starters, circuit breakers, controllers and other equipment with adjustable settings both manual and programmable settings.

3) Statement of satisfactory demonstration of all instruments, devices and equipment functions over full range of operation. (Any failures or incorrect calibrations or settings detected shall be reason to halt demonstration tests and reschedule after adjustments and recalibrations have been completed.)

4) Factory Technician report stating that all calibrations, settings and adjustments have been completed and that equipment has been functionally tested by Factory Technician on site. (Where report is found to be inaccurate, the Technician shall make necessary on site adjustments and shall issue new report, and where second report is required, a Factory Manager shall sign report attesting to its accuracy. There is no exception to this requirement. Contractor shall be responsible for all factory set up, testing and demonstration costs until system is accepted by the Engineer. Any additional testing as result of non-acceptance by Engineer shall be at Contractor's expense.

5) As-Built Drawings (Point to point wiring diagrams for every electrical device installed on this project with tags and applicable schedules shall be available at time of testing. Lack of this requirement will result in cancellation of testing until complete documentation is available. This will allow checking of wiring accuracy at time of testing.)

D. A state licensed Electrician shall be present at all scheduled inspections.

E. Prior to testing system, PLC programs or HMI programs shall be furnished on CD for review by Engineer. Provide any special software necessary to run and test complete program.

END OF SECTION

SECTION 16016

CONTROL PANELS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of the following:

1. Control switches, relays, transformers, alarm panels, terminal blocks, power suppliers, and accessories.
2. Panel fabrication and assembly requirements.

B. The purpose of this specification section is to assure quality construction and fabrication of control panels for this project. Any Manufacturer that cannot meet the requirements of this specification section will not be considered.

C. This specification section applies to both individual control panels and control sections of motor control centers. Refer to other electrical specification sections for additional requirements.

D. All equipment and devices shall be NEMA rated. IEC rated equipment and devices are not acceptable.

E. Only control panels fabricated by shops listed in Section 16012, Electrical Work, paragraph entitled Materials are acceptable. No exception unless control panel is off-the-shelf product provided as part of process equipment installation and is manufactured by the equipment supplier, or where control panel is specified as part of equipment specified by Engineer in other Specification Sections.

F. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.2 REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control and Systems.

B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.

C. NEMA ICS 3 - Industrial Systems.

D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

E. NEMA ST 1 - Standard for Specialty Transformers (Except General Purpose Type).

F. ISA - Instrument Society of America.

G. UL - Underwriter Laboratories.

H. FM - Factory Mutual.

I. IEEE - Institute of Electrical and Electronic Engineers.

J. NFPA - National Fire Protection Association.

K. NEC - National Electrical Code.

L. JIC - Joint Industrial Council.

M. ANSI - American National Standards Institute.

1.3 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval.

B. Submit shop drawings indicating layout of completed assemblies, interconnecting cabling, dimensions, weights, and external power requirements. Show available space and proposed equipment dimensions. Provide special fabrication where required to fit available space.

C. Submit product data for each component specified and/or included in control panel.

D. Submit manufacturer's certificate that all equipment meet or exceed specified requirements.

E. Submit manufacturer’s proof of certification by U.L. for construction of U.L. listed control systems.

F. Submit manufacturer's installation instructions.

G. 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.

H. Provide CAD files of all diagrams, equipment views, and material and device schedules on CD, and include with submittals. Only one (1) CD required for Engineer.

1.4 PROJECT RECORD DOCUMENTS

A. Submit record documents reflecting actual construction.

B. Accurately record actual locations of control cabinets and input and output devices connected to system. Include interconnection wiring and cabling information and terminal block layouts in control cabinets, inserted in an aluminum drawing pocket on inside of door.

C. During drawing submittal phase, submit detailed information consisting of ladder logic and line code, complete input, output, relay and controls identification labels and written description of program operation. Ladder logic diagrams submitted shall contain a written descriptive note for each line, describing the function and logic of that line. Submit all documents in hard copy and on CD.

D. Submit factory-testing procedures proposed to verify all input, output, loop operation, and system logic verification. Testing procedures submitted shall detail, as a minimum, verification of the following required minimum functions:

E. Verify motor start, motor stop, and level or pressure alarm outputs by simulating signals representing levels or pressures.

F. Verification of each discrete input via external manually operated connection.

G. The system shall be tested and verified with all external devices required to simulate field connections connected simultaneously for a full system test.

H. Shop Drawings shall be submitted in complete packages grouped to permit review of related items as generally outlined in these specifications.

I. All Shop Drawings shall be bound in three ring binders with complete indexing and tab dividers. All equipment information shall be completely tagged and labeled to correspond with the drawings.

J. Review of Shop Drawings shall be for conformance with Contract Documents and with regard to functions specified to be provided.

K. Panels, Consoles, and Cabinets Information:

L. Layout Drawings include the following:

1. Front, rear, end, and plan views to scale.
2. Dimensional information.
3. Tag number and functional name of components mounted in and on panel, console, or cabinet.
4. Product information on all panel components.
5. Nameplate location and legend including text, letter size, and colors to be used.
6. Location of anchoring connections and holes.
7. Location of external wiring and/or piping connections.
8. Mounting and installation details.
9. Proposed layouts and sizes of graphic display panels.

M. Wiring and/or piping diagrams include the following:

1. Name of panel, console, or cabinet.
2. Wiring sizes and types.
3. Piping and tubing sizes and types.
4. Terminal strip numbers.
5. Color coding.
6. Functional name and manufacturer's designation for components to which wiring and piping are connected.

N. Electrical control schematics in accordance with JIC standards.

O. Plan showing equipment layout in each area.

P. Field wiring and piping/tubing diagrams, include the following:

1. Wiring and piping/tubing sizes and types.
2. Terminal strip numbers.
3. Color coding.
4. Conduits in which wiring is to be located.
5. Location, functional name and manufacturer's designation of items to which wiring and/or piping are connected.
6. Point-to-point wiring diagrams.

1.5 OPERATION AND MAINTENANCE (O&M) DATA

A. Submit operation and maintenance data for Engineers approval.

B. Include bound copies of operating and programming instructions.

C. Include component replacement, adjustments, and preventative maintenance procedures and materials.

D. The Contractor shall provide O&M Manuals in accordance with the requirements of Section 01730. In addition to required hard copies, provide one (1) CD with complete Control System O&M manual for Engineer's use.

E. Submit O&M manuals prior to the time the control system equipment is delivered to the site.

F. O&M manuals shall be submitted in hard-back three-ring loose-leaf binders with a complete table of contents and drawing indexes for each binder and dividers for each section. Binders shall have clear plastic pocket on the back side. Enclose in the pocket a computer printed label including facility name, address and job number. Stick on labels shall not be used. Information shall be professionally written and assembled - a simple collection of cut sheets is not acceptable.

G. The O&M manuals shall include the following as a minimum:

1. Name, address, and telephone number of the control system supplier's local service representative.
2. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided. Specific, not general, data is required.
3. Copy of all approved submittal information and system shop drawings with corrections made to reflect actual system as tested and delivered to the site for installation. Half-size black line reproductions shall be provided for all shop drawings larger than 11x17 inches.
4. Provide a set of O&M manuals including, red line control, and electrical schematics for substantial completion inspection at the facility site.
5. Provide and include in the O&M manual, control system description, and system operation sequence instructions. This shall be concise and professionally written.
6. Control and loop diagrams, electrical drawings, and system description and operation instructions shall be submitted in a separate binder.
7. Provide individual sets of O&M manuals for each station when project includes group of stations.
8. O&M Manuals shall professionally written and not be an assembly of Manufacturer's cut sheets.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the assembled control products specified in this specification section with minimum 3 years documented experience, which maintains service facilities within 200 miles of project, and with proven compatibility with Owner's existing type facilities.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in acceptable condition and in protective wrappings.

B. Store and protect products from damage.

C. Accept products on site in factory containers and verify damage.

D. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

1.8 ENVIRONMENTAL REQUIREMENTS.

A. Maintain temperature above 32°F and below 104°F during and after installation of products.

B. Maintain area free of dirt and dust during and after installation of products.

C. Provide temporary heating and air conditioning units and equipment required to maintain environmental conditions specified for control and MCC panels.

1.9 MAINTENANCE SERVICE

A. Provide manufacturer's Maintenance Services of control systems for one year from Date of Substantial Completion.

1.10 RECORD DRAWINGS AND DOCUMENTATION

A. The Contractor and control systems supplier shall revise system shop drawings, submittals and documentation to reflect as-built conditions in accordance with the requirements of the supplemental requirements below.

B. Six copies of all revised shop drawings and documentation shall be submitted to the Engineer for approval to replace out-dated drawings and documentation contained in the System O&M Manuals. Half-size black line sets shall be provided for all drawings larger than 11x17. Specific instructions for out-dated drawing removal and replacement shall be provided with the record drawing submittal.

C. Half-size black line prints of wiring diagrams applicable to each control panel shall be placed inside a clear plastic envelope and stored in a suitable print pocket or container inside each control panel.

D. Six copies of the following reports shall be submitted to the Engineer:

1. Factory Test Reports if specified.
2. Installation Inspection, Field Calibration, and Field Testing Reports.

E. All updated record drawings shall be delivered to Engineer for approval prior to final acceptance of construction work.

PART 2 - P R O D U C T S

2.1 PANEL CONSTRUCTION

A. Wiring Methods:

1. All interconnect wiring inside panel to be stranded copper conductors intended for panel wire use. Thermoplastic covered wire is not to be used.
2. All wiring to be bundled and laced with wax cord or nylon cable ties or, may be installed in panduit wireways. Cable ties shall be spaced at intervals not to exceed 4 inches. All wiring between device terminals and wireways shall be orderly and tied. Wire markers shall be visible without removing wiring from a wireway.
3. Where wireways are used, they shall be properly sized for wiring contained within and shall not be oversized. Wireway fill shall not exceed 75 percent of wireway capacity and shall not be less than 25 percent of wireway capacity. Wireway width to depth ratio shall not be less than 2 to 1.
4. All cable ties shall be trimmed and loose ends shall not exceed 1/8 inch in length after trimming.
5. Wiring bundles shall be secured in place with nylon cable clamps that are attached to the mounting plate with stainless steel bolts. Cable bundles attached to the back side of a front plate or cover plate shall be via stainless steel studs welded to the plate before painting. Counter sunk head stainless steel bolts may be used in which case the head finish shall match the panel finish in color so as to provide a neat appearance of the front panel. Adhesive type cable tie restraints are not allowed.
6. Wire splices inside panels are prohibited. Wire nuts and similar devices are prohibited. Split, bridged, or extended circuits shall be done via use of terminal strips only except where looped grounds or

power circuits may be used where wire is not cut and is attached at each device with proper terminal devices. All circuits shall be continuous and unbroken.

7. Use wire strippers of proper size to avoid wire nicks or cut strands. Trimming strands to make wire fit a terminal is prohibited. Provide proper sized wire and/or terminal device.

B. Device Mounting:

1. All devices mounted on plates or doors shall be installed in holes that are punched with dies that specifically match the device requirements. Holes may be formed with machine tools. No mounting holes are to be cut with saws, nibblers, or similar tools not made for professional panel fabrication. All edges to be smooth and free of burrs.
2. Panels that have scratches or are otherwise damaged when mounting devices may be touched up with the same identical paint where dried under the same conditions of heat or drying as the original panel finish. Repairs shall not be detectable.
3. All panels to be constructed of stainless steel. All doors to be constructed so as to prevent flexing or twisting movement when opened. This is especially of concern when devices are mounted on door. Lightweight doors are not acceptable. Inner panel is to be stainless steel. Plexiglas panel is not acceptable.
4. Where panel is provided by an Equipment Manufacturer as part of the specified equipment package, the Equipment Manufacturer shall be held to these same standards and requirements. Providing panels of less quality than these standards will not be acceptable regardless of Equipment Manufacturer's standard panel specification described in equipment data sheets. Other specification sections of lesser quality do not supercede the requirements of this specification section.
5. No devices shall be mounted in outer door of panels except where specifically noted on plans.
6. Where instruments are mounted in panel doors or plates, the mounting devices, clips, and brackets shall be type provided by the Instrument Manufacturer or shall be specifically fabricated for the purpose. All panel mounted instruments shall have enclosures that cover any exposed circuit boards or components on the back side of the instrument.
7. Components are to be attached with bolts, washers, and nuts properly sized and made for the purpose applied. Screws or self-tapping screws are not acceptable for mounting components, except self-tapping stainless screws shall be used for mounting nameplates.
8. Do not mount temperature sensitive devices near heat producing components such as resistors or transformers.
9. Arrange all devices for easy identification, removal, and repair. Removal of any device shall not require removal or disturbing other components.
10. Wet devices shall be located in lower part of panel or cabinet with metallic spray shield installed above, separating other electrical devices.
11. DIN rail mounted devices shall be made for purpose and shall be standard sized components. Micro and miniature type components are not acceptable.
12. All devices shall be of type that is readily available and not special order type components that are not standard manufactured units.
13. All components, parts, and devices are to be identified at their locations with approved labels or nameplates. Provide 8 ½ x 11 inch laminated parts list in steel or hard plastic door pocket along with the control diagrams.
14. All over current devices shall be fast acting circuit breakers. Fuses are not allowed except where specifically called for. Where fuses are specified, provide ten (10) each spare fuses in addition to requirements of other specification sections.
15. Fused circuits are not acceptable for power or control devices. Circuit breakers shall be used for all overcurrent protection purposes. Any use of fuses shall be acceptable where specifically approved by Engineer in writing for each specified panel.
16. All display screens or readouts shall be mounted in panel at height of 60 inches above level where operator stands. This must be accounted for where panels are installed on concrete pads or other elevated structures.

C. Terminals:

1. All terminations for interfacing with external wiring shall be via screwtype terminal strips that have numbered markings to identify termination points. All terminals to have compression plates made specifically for the purpose, in addition to the screws. Round washers are not acceptable substitute for the compression plates.
2. All terminals or exposed wiring with more than 120 volts to ground or 300 volts between legs are to be shielded with non-metallic, non-conducting insulating material made for the purpose of avoiding accidental contact. Label all shields and devices in a recognizable manner with warning nameplate orsign.
3. Locate terminal strips in accessible location in panel to allow easy access when making terminations. Provide nameplate for each terminal strip.

D. Miscellaneous:

1. Door fasteners shall be of highest quality, designed to withstand repeated engagement and disengagement without damage to retaining parts, which shall be firmly attached to the panel frame members. Fasteners shall be properly aligned with retainer parts. Lightweight fasteners are not acceptable. Any fasteners failing before warranty period expires shall be replaced with different type fastener that is acceptable to Owner and Engineer.
2. All outdoor panel doors to be NEMA 4X 316 or 6P (as shown on plans) stainless steel with three (3) point latching handle and locking hasp. Key type handles are not acceptable. No control devices are allowed on outer door of outdoor enclosures.
3. All attachments and studs that are welded to stainless steel panel, enclosure, or plate shall be properly welded in such a manner that does not discolor finish. All welds shall be properly cleaned, buffed, and treated to provide a neat appearing finish. Any discolored plates or enclosures shall be replaced.
4. Panel Manufacturer shall send Engineer color photographs or e-mail color photo files of finished panel where shop inspection has not been conducted before shipping. Photos shall be of quality and clarity so as to allow evaluation of finished panel quality. No panels shall be delivered to job site without this review and approval in writing by Engineer and, where delivered without this approval may be rejected by Engineer. Any delay in construction schedule due to failure to satisfy this requirement will be at fault of Contractor.
5. Provide laminated 8 ½ x 11 inch control diagrams that show all components, wiring, andterminals and enclosure in aluminum, steel or hard plastic door pocket. Diagrams must be identical to as-built drawings and O&M Manuals and show latest configuration of construction.
6. Provide 120-volt GFI type receptacle and 12 inch or 24 inch LED, enclosed, weather tight, light fixture in each outdoor panel. Provide door switch to activate light. Provide separate circuit breaker for receptacle and light that is not common to any control circuits. Provide 120-volt space heater with thermostat control.
7. All hydraulic or pneumatically operated devices to have shut-off valves. Provide block and bleed valves for all autosensory lines. Route bleed line to outside panel and outside rooms. All autosensory lines entering panel shall be via bulkhead connectors made for that purpose.

E. Programming: Where specifications require programming to be conducted by "Programmer," provide all software and coordinate loading and testing.

F. Cabinet and Enclosures Heights: Cabinet, panel, and enclosure heights shall not exceed 6 feet – 6 inches from floor to top fastening devices to allow access by Operator without use of ladders or steps to open enclosure doors.

G. All control panels shall have heaters to remove condensation and shall have satisfactory means of cooling to maintain temperatures below the warranty levels of each device installed inside the panels. Outdoor panels shall be NEMA 4X or 6P (as shown on plans) stainless steel and rated to operate in 110 degree Fahrenheit ambient temperatures and at 95 percent humidity.

H. Relocation of panels up to 40 feet from where shown may be required and shall be included in bid cost.

I. Adhesive attachments are not allowed.

J. All control panels that have a solid-state controller or PLC, shall have data port.

2.2 CONTROL SWITCHES

A. Manufacturers

1. Square D Class 9001, Type K
2. Allen Bradley 800T
3. Or, pre-approved substitution

B. Construction:

1. Heavy duty
2. Watertight
3. Oil-tight
4. Base mounting
5. Flush panel mounting
6. Size to mount in 30.5 mm diameter opening without adapter. Smaller units are not acceptable.
7. Padlock attachments, where required, constructed of metal. Plastic material is not acceptable.
8. Legend plates, as required, for type of operation or as specified elsewhere.

C. Pushbuttons:

1. Flush head unless specified elsewhere.
2. Contact Blocks:
   a. Double break silver contacts
   b. AC Ratings: 7,200 VA make, 720 VA break
   c. Single pole, double throw or double pole, single throw
   d. Up to six (6) tandem blocks
   e. Pushbutton "Run/Stop" switches for motor controls not allowed. Use selector switches only.
3. Maintained contact unless specified elsewhere.
4. Non-illuminated.
5. Legend plates, as required, for type of operation or as specified elsewhere.

D. Selector Switches:

1. Maintained position unless specified elsewhere.
2. Contact Blocks:
   a. Double break silver contacts
   b. AC Rating: 7,200 VA make, 720 VA break
   c. Single pole, double throw or double pole, single throw
   d. Up to six (6) tandem blocks
3. Operators:
   a. Number of positions as specified elsewhere
   b. Standard knob type unless specified elsewhere

E. Pilot Lights:

1. LED, high visibility type
2. Colored lenses as specified elsewhere
3. Interchangeable lenses
4. Push to test
5. Legend plates as specified elsewhere

2.3 MOTOR STARTER CONTROL RELAYS

A. Manufacturers

1. Square D
2. Or pre-approved substitution

B. Construction:

1. Industrial type
2. 300 V rated
3. AC operation
4. Pressure wire connectors

C. Operating Data:

1. Pickup Time: 11 ms maximum
2. Dropout Time: 6 ms maximum

D. Coil:

1. Molded construction
2. 120 VAC, 60 Hz
3. Continuous rated
4. Color coded to indicate status
5. Pilot duty
6. 60A make, 6A break, (120V inductive)

E. Contacts:

1. Double break
2. Silver alloy
3. Convertible
4. Color coded to indicate status
5. Pilot duty
6. 60A make, 6A break, (120V inductive)

F. Track mounting capability

G. Accessories:

1. Add-on pole attachment
   a. 4 NO and 4 NC contacts
   b. Add-on to 0 to 4 pole relay
2. Latch attachment
3. Pneumatic Timer Attachment:
   a. Single pole, double throw, double break timed contact
   b. Adjustable 0.2 to 60 sec.
   c. Repeat accuracy of $\pm$ 15 percent
   d. Convertible timing modc.
4. Transient Timing Mode: Suppress coil transients to 300 V or less.

2.4 CONTROL RELAYS

A. Contacts: NEMA ICS 2; three (3) Form C contact sets.

B. Rating: NEMA ICS 2; 120 volts, 10 amperes inductive.

C. Coil Voltage: 120 volts, 60 Hz, AC, or, as shown on Plans.

D. Features: 11 pin tube socket relay base, external color-coded test button, mechanical and electrical status indications, impact resistant thermoplastic case.

E. Manufacturer: Turck, Inc. or approved substitution, unless shown otherwise on plans.

2.5 TIME DELAY RELAYS

A. Contacts: NEMA ICS 2; three (3) Form C contact sets.

B. Contact Ratings: NEMA ICS 2; DPDT Class 120 volts, 10 amperes inductive.

C. Coil Voltage: 120 volts, 60 Hz, AC, or, as shown on Plans.

D. Description: Control relay as specified above with added Time Cube Module as manufactured by Turck, Inc., series CT3, on or off delay as indicated.

E. Features: DIPswitch selectable timing ranges of 0.2-3 sec, 0.8-12 sec, 0.1-1.5 min and 0.8-12 min (unless noted otherwise on plans); externally adjustable graduated time dial; solid-state digital timing system.

2.6 CONTROL POWER TRANSFORMERS

A. Transformer: NEMA ST 1; machine tool transformer with isolated secondary winding.

B. Power Rating: 250 VA or 200 percent power requirement (whichever is greater).

C. Voltage Rating: 120/240 volts primary; 120 volts secondary, one-phase.

2.7 TERMINAL BLOCKS

A. Manufacturers:

1. Entrelec, Inc.
2. General Electric Company
3. Bussmann
4. Or, approved substitution

B. Terminal Blocks: Provide terminal blocks with circuit breaker overcurrent protection.

C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

E. Provide ground bus terminal block, with each connector bonded to enclosure.

2.8 MISCELLANEOUS DEVICES

A. Manufacturer: As shown on plans.

B. Description: As shown on plans.

C. As described in Section 16936, Pilot and Miscellaneous Control Devices.

2.9 DATA LINE PROTECTION - (AS SHOWN ON PLANS OR SPECIFIED IN OTHER SECTIONS)

2.10 ACCESSORIES

A. Plastic Wireway:

1. Panduit Corp.
2. Anixter Brox., Inc.
3. Delaware Industries, Inc.

B. Description: Plastic slotted wireway with snap-on locking covers. White or grey color.

C. Refer to paragraph entitled Panel Construction herein for size restrictions.

2.11 ELAPSE TIME METER

A. Manufacturers:

1. Cramer #635G/HRS.
2. Digits: Five (5), non-resettable
3. Power: 120 VAC, 60 Hz

B. Manufacturers:

1. Cramer #635S surface mounted.
2. Digits: Five (5), non-resettable
3. Power: 120 VAC, 60 Hz

2.12 TIMERS

A. 24-hr Clock Timer (Repeat Cycle):

1. Manufacturers:
   a. Tork Time Controls
   b. Intermatic
   c. Or pre-approved substitution
2. Mounting: Surface
3. Display: 24-hr LCD
4. Contacts: One (1) SPDT rated 20 A
5. Set Points: 288 per 24 hr.
6. Skip Feature: 1 to 7-day adjustable
7. Minimum On-Off Time: 5 min.
8. Time cycle programmable by keypad
9. Power: 120 VAC, 60 Hz

B. Interval/Duration Timer (Rear of Panel):

1. Manufacturers: As indicated on drawings
2. Mounting: Plug-in with dust tight cover
3. Type: Integrated circuit
4. Range: As indicated on drawings
5. Contacts: Two (2) DPDT contacts rated 10 amp
6. Power: 120 VAC, 60 Hz

2.13 PRESSURE SWITCHES – (NOT APPLICABLE)

2.14 ALTERNATOR

A. Manufacturers:

1. Diversified Electronics:
   a. Two (2) Pump Duplexor:
      1) 24 VAC/DC, ARA-24-ABA.
      2) 48 VDC, ARA-48-ABA
      3) 120 VAC/DC, ARA-120-ABA
      4) 208 VAC, ARA-208-ABA
      5) 240 VAC, ARA-240-ABA
   b. Three (3) Pump Triplexor:
      1) 24 V, ARA-24-AFE 2) 120 V, ARA-120-AFE
   c. Four (4) Pump Quadraplexor:
      1) 24 V, ARA-24-AGE 2) 120 V, ARA-120-AGE
      3) Approved substitution by other Manufacturers
   d. Two (2) or Three (3) Pump Duplexor/Triplexor: 120 V, ARA-120-AME
   e. Three (3) or Four (4) Pump Triplexor/Quadraplexor: 120 V, ARA-120-ANE
2. Time Mark Corporation: 120 V, B 471
3. Or pre-approved substitution

B. Provide automatic alternation of energizing motor starters.

C. Permit operation of units singly or together as called by pilot devices.

D. N.O. auxiliary contacts from motor starters required to operate alternator.

E. Alternator shall provide for operation of standby or lag unit through second pilot device in event of failure of lead unit or first pilot device or alternator coil.

F. With pump selector switch for operation of two (2), three (3), four (4) and five (5) pump systems.

2.15 PHASE FAIL RELAY

A. Diversified Electronics #SLD-440-ALE, 480 Volt, 3 Phase.

B. Diversified Electronics #SLD-220-ALE, 240 Volt, 3 Phase

C. Pre-approved substitution

2.16 UNIVERSAL AC CURRENT SENSOR

A. Manufacturer:

1. SSAC, Inc. – P.O. Box 1000, Baldwin, NY, 13027
2. Or, approved substitution

B. ECS, ECSH, and ECSL Series: Provides relay contact closure when current reaches pre-set level.

C. Install per Manufacturer's instructions.

D. Sensor to be rated at 125 percent of current rating.

2.17 CURRENT TRANSDUCER

A. Manufacturers:

1. NK Technologies
2. Ohio Semitronics, Inc.
3. Or, approved substitution

B. AT Series: Current transformer with signal conditioner. Split or solid-core as applicable. 420 model with 4–20 mA output. Self-powered. 0 – 200 amp range. U.L. listed.

C. A.C. Current Transformer Model No. MCT5, 005E or 005E2 (as shown on plans) with Manufacturer's recommended CT rated per circuit maximum amps x 1.25.

D. AT/ATR Series: 0 – 200 amp range or, as required by motor current rating.

E. Transducer to be rated for 125 percent of current rating.

F. Size unit to detect peak inrush current of motor.

2.18 VOLTAGE TRANSDUCER – (NOT APPLICABLE)

2.19 DC INPUT, FIELD CONFIGURABLE ISOLATOR – (NOT APPLICABLE)

2.20 SIGNAL CONVERTER/ISOLATION AMPLIFIER– (NOT APPLICABLE)

2.21 ADDITIONAL DEVICES

A. See Section 16936, Pilot and Miscellaneous Control Devices, for additional devices.

PART 3 - E X E C U T I O N

3.1 SYSTEM DESCRIPTION

A. Use control diagrams on plans, equipment manufacturer's data, P&ID's, Flow Diagrams, electrical plans and all other information in Construction Documents to verify intent of system controls before preparing shop drawing diagrams for Engineers review and acceptance. Where control sequence is not clear or, where not familiar with type of control, consult Engineer for clarification.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and intent of Contract Drawings. Provide sufficient clearance for calibration and maintenance access.

B. Do not install products until major construction is complete and building interior is enclosed and heated.

C. Connect input and output devices as shown or, as intended, on Drawings.

D. Provide complete testing.

3.3 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems and conduct tests.

3.4 DEMONSTRATION

A. Provide systems demonstration in presence of Owner and Engineer.

B. Demonstrate operation of Controls.

C. System demonstration to include the following:

1. Complete verification of all field wiring.
2. Demonstration of functionality of each field device action.
3. Complete demonstration of each alarm by simulation of actual field device action.

D. Coordinate any programming requirements as described in controller, PLC, RTU or CCU, SCADA, and other specification sections.

3.5 TRAINING

A. Provide minimum four (4) hours of "hands-on" instruction each for Owner's staff. To be conducted at project site by control systems manufacturer's representative, at no additional cost to Owner. Training is to be conducted after all control systems are fully operational. See Section 16012, Electrical Work, for additional requirements and refer to other equipment.

B. Provide minimum two (2) weeks' notice to Engineer and Owner before conducting training.

3.6 WARRANTY

A. Electrical equipment shall be warranted in accordance with the requirements of Section 01010. 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. Included under this warranty shall be all equipment, devices, hardware, and software.

B. All materials and equipment installed shall have full warranty from manufacturer that guarantees equipment is rated for the harsh marine Electrical/Mechanical environment in which it is installed. Where manufacturer's products fail prematurely, manufacturer shall be fully responsible for new replacement and shall not have option of declaring that failures were caused by environment and its affect on the product. Contractor is fully responsible for assuring that product manufacturers are aware of this condition and that warranty statement is included in shop drawings. Failure to do so will be at full expense of Contractor and at no additional cost to Owner. Where warranty requirements are shown in other sections, the more stringent requirement shall have precedence.

C. 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 five (5) working days from date of notice are subject to Owner making other arrangements for repair and backcharging Contractor. This requirement is a condition of this contract.

D. 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.

END OF SECTION

Section 16060

ELECTRICAL DEMOLITION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Electrical demolition.

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. 305 - Temporary Wiring

2. City of Galveston Electrical Code.

1.03 SUBMITTALS

A. Annotate existing drawings to sequence the demolition of systems, equipment removal and temporary hook-ups.

B. Schedule with Owner's Representative for required shut-downs to accommodate system demolition and installation of temporary facilities.

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 discrepancies to the Owner's Representative before disturbing the 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 City all items and systems in good operating condition.

PART 2 P R O D U C T S

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

2.02 DESIGN AND CONSTRUCTION

A. The temporary electrical wiring and facilities shall be designed and constructed in strict compliance with NEC - Article No. 305 and the City of Galveston Electrical Code.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with utility company to provide continuous service to operating equipment.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, notify the Owner's Representative and get approval. 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's Representative at least one week before partially or completely disabling system. Minimize the outage duration.

E. Adding Load to Existing Electrical System: Perform a load analysis to assure that the existing power distribution system (MCC, service, conductors, panel, breakers, feeders, branch circuits, etc.) is not overloaded if additional load is added to existing equipment.

F. Existing electrical conduit and wire may not be reused to feed new equipment except by written authorization from the Owner's Representative.

3.02 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

D. 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.

E. Disconnect and remove abandoned panelboards and distribution equipment.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing installations which remain active. Modify installation or provide access panel as appropriate.

I. Extend existing installations using materials and methods as specified for new work.

3.03 DISPOSAL AND SALVAGE

A. Salvage electrical and instrumentation equipment removed from existing facilities for reuse as applicable.

B. Material and equipment which can be reused or salvaged remains the property of the City of Galveston unless specifically indicated in the Specifications or Drawings or as designated by the Owner's Representative. Equipment to be retained by the City of Galveston shall be delivered to a specified location by the Contractor.

C. Materials and equipment which cannot be reused or salvaged will be removed and disposed by the Contractor.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are 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 arrangement.

3.05 INSTALLATION

A. Install relocated materials and equipment under the provisions of Section 02050 – Site Demolition.

B. Electrical installations and materials shall conform to the current issue of the following standard and codes: American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC), City of Galveston Electrical Code, and material and workmanship.

C. All material shall be free of defects and in safe working condition which will meet electrical classification and functional requirements.

D. Testing shall be made during the course of construction or at the completion of the job. These tests shall be made by the electrical contractor. The contractor shall furnish all test equipment.

E. The job will not be complete until work has been inspected and trial start up has been successfully completed.

END OF SECTION

Section 16111

CONDUIT, FITTINGS, AND BODIES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Conduit, fittings, and bodies.

1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C 80.1 - Rigid Steel Conduit - Zinc Coated.

2. ANSI C 80.4 - Fittings for Rigid Metal Conduit.

B. Federal Specifications:

1. W-C-58 C - Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron.

2. W-C-1094 - Conduit and Conduit Fittings Plastic, Rigid.

3. WW-C-566 C - Flexible Metal Conduit.

4. WW-C-581 D - Coatings on Steel Conduit.

C. National Electrical Manufacturers Association (NEMA):

1. NEMA RN 1 - Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.

2. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

3. NEMA TC 3 - 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 514 B - Fittings for Conduit and Outlet Boxes.

4. UL 651 - Schedule 80 Rigid PVC Conduits.

5. UL 651 A - Type EB and A Rigid PVC Conduit and HDPE Conduit.

6. UL 886 - Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.

F. City of Galveston Electrical Code.

1.03 SUBMITTALS

A. Make submittals following Section 01330 - Submittal Procedures:

1. Manufacturer's cut sheets, catalog data.

2. Installation, terminating and splicing procedure.

3. Instruction for handling and storage.

4. Dimensions and weight of products.

5. Code compliance certificate.

6. Conformance certificate.

1.04 QUALITY ASSURANCE

A. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C 80.1.

B. Flexible conduit shall pass the tension, flexibility, impact, and zinc coating test described by UL 1.

C. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC 2, UL 651 and 651 A and Federal Specification W-C-1094 A.

1.05 DELIVERY STORAGE AND HANDLING

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.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Rigid Steel Conduit:

1. Allied Tube and Conduit.
2. Triangle Wire and Cable, Inc.
3. Wheatland Tube Company.

B. PVC Coated Steel Conduit:

1. Occidental Coating Company (O-Cal Blue).
2. Robroy Industries, Inc.
   a. Rob-Roy Red
   b. Plasti-Bond Red
   c. Perma-Cote Green

C. PVC Rigid Conduit:

1. Cantex.
2. Carlon Industries, Inc.

D. Conduit Fittings and Bodies:

1. Appleton Electric.
2. Crouse-Hinds.
3. Killark Electric Manufacturing Company.
4. O-Z/Gedney.

E. Liquidtight Flexible Conduit:

1. Anamet, Inc.

2. Electriflex Company.

3. Triangle Wire and Cable, Inc.

2.02 MATERIALS AND EQUIPMENT

A. Design Conditions. Use electrical conduit, fittings, and bodies designed for service in areas as specified in Section 16010 - Basic Electrical Requirements and this section to form a continuous support system for power, control, and instrument cables or any combination thereof.

B. Conduit and Fittings:

1. Rigid Steel Conduit and Fittings.

a. Rigid steel conduit and rigid steel conduit bends, nipples, and bodies shall be hot-dipped galvanized and shall comply with the latest ANSI C 80.1, UL 6, Federal Specification WW-C-581 D, and NEC Article 346-15.

b. Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces.

c. Fittings and bodies and covers for rigid steel conduit shall be steel or cast-iron and shall comply with ANSI C 80.4, UL 514 B, and Federal Specification W-C-58 C.

2. PVC-Coated Rigid Steel Conduit and Fittings

a. PVC-coated conduit, fittings, bodies, and covers shall conform to NEMA RN 1 (Type A). Rigid steel galvanized conduit and fittings shall conform to Federal Specifications WW-C-581 D and ANSI C 80.1. PVC-coated rigid metal conduit must be UL listed with PVC as the primary corrosion protection. Conduit bodies shall conform to UL 514 B and Federal Specification W-C-58 C. PVC-coated fittings for general service locations must be UL listed with the PVC as the primary corrosion protection. Provide sufficient coating for touch-up after installation.

b. PVC-coated couplings shall be of the ribbed type.

c. Condulet covers shall have encapsulated stainless steel thumb screws.

d. Condulets and covers shall be of malleable iron or ferroalloy material before coating.

e. Urethane coating shall be a minimum of 2 mil thickness on the interior of the conduit and the interior of fittings, condulets, covers, and bodies.

3. Flexible and Liquidtight Flexible Metal Conduit and Fittings

a. Use liquidtight flexible metal conduit manufactured in accordance with UL 1 and Federal specification WW-C-566 C.

b. Fittings used with liquidtight flexible metal conduit shall be the PVC-coated type. Thoroughly ground the conduit to the fittings and through the fittings to the box or enclosure to which it is attached.

c. Flexible couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501-4 (a&b), and Federal Specification W-C-586 C.

4. PVC Conduit and Fittings. Use PVC conduit, bends, and fittings, which comply with NEMA TC 2, W-C-A, and NBC Article 347-17 for above ground and underground installation. Conduit shall be Schedule 80.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements.

B. Verify the actual physical conduit route from the conduit plan drawings and prepare the conduit support system.

C. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.

3.02 INSTALLATION

A. Install PVC-coated conduits in all outdoor locations, inside valve vaults and wet wells, lift station drypits, areas that are not air-conditioned, and in all other corrosive and wet environments. Install PVC-coated conduit in strict accordance with manufacturer's instructions. Use installers certified by the manufacturer.

B. Install rigid galvanized steel (RGS) conduits in dry, inside, air-conditioned locations only.

C. Install PVC conduits in reinforced duct banks or encased in concrete slabs. For stub-ups, use PVC coated rigid steel elbows.

D. Run exposed conduit parallel or perpendicular to walls, ceilings or main structural members. Group multiple conduits together where possible. Conduit shall not interfere 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, trip hazard, or interfere with normal plant operating and maintenance procedures. A minimum overhead clearance of 8 feet shall be maintained in passageways. All conduits installed across walkways shall have concrete or aluminum trip plates installed.

E. 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.

F. Identify conduit at termination points like MCC, light fixtures, control panels, receptacles, panels, and junction boxes.

G. Not more than 3 equivalent 90 degree bends will be permitted between outlets. Provide bonded expansion fittings at building expansion joints.

H. 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.

I. 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. Threads shall be cut 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 non-corrosive Carbozinc No. 11 as manufactured by the Carboline Company, coal tar enamel or zinc rich epoxy primer on the threads of steel conduit before connections are made.

J. 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. Use a solvent, or the same patching material to seal around the edges of conduit fitting covers.

K. Make up changes in direction of conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise.

L. 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.

M. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign matter into the conduit system by properly capping terminations.

N. 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 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.

O. Fit all 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.

P. Where conduit terminates in sheet metal enclosures and where no threaded hubs are provided, fit the conduit with double locknuts and bushings. Sheet metal enclosures made of stainless steel or aluminum located outside or in any other wet, damp, or corrosive areas shall be furnished with PVC-coated threaded hubs. Restrict side penetrations to the lower one third of the enclosure.

Q. Provide flexible Liquidtight metallic conduit where necessary to allow for movement or to localize sound or vibration, at transformers, at motors and any other rotating equipment. Flexible metal conduit shall be used as fixture whips only.

R. Seal all openings or holes where conduits pass through walls or floors. When passing through a firewall or floor, use a fire-rated seal per the typical detail included in the Drawings. Certain walls, as indicated on the drawings, require environmental (air-tight) seals; seal as indicated on the Drawings.

S. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area (as shown on Drawings). Install type CSBE removable sealing fittings to seal pump cables between wet well and first junction box. If a junction box is not used, install the CSBE seals at the wet well and the control panel.

T. Unless otherwise indicated on 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.

U. 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 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.

V. 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.

W. 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.

X. 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. 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.

Y. 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.

Z. 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.

AA. 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, 2-hole straps shall be used. 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 3/6 stainless steel.

BB. Install conduits supported form building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit.

CC. All Conduit tops installed in concrete lift station shall be PVC coated rigid.

END OF SECTION

Section 16120

600-VOLT POWER AND CONTROL CABLE

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Specifications for 600-volt power and control cable.

1.2 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 310 - Conductors for General Wiring

B. Underwriter's Laboratories (UL)

1. UL 83: Thermoplastic Insulated Wires and Cables

2. UL 1063: Machine Tool Wires and Cables

C. American Society for Testing and Materials (ASTM)

1. ASTM B 3: Soft or Annealed Copper Wires

2. ASTM B 8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

D. Insulated Cable Engineers Association (ICEA), ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5)

E. City of Galveston Electrical Code

1.3 SUBMITTALS

A. Make submittals following Section 01300 - Submittal Procedures.

1. Manufacturer's cut sheets, catalog data

2. Instruction for handling and storage

3. Dimensions and weight

4. Conformance certificate

1.4 QUALITY ASSURANCE

A. Tests. Cable shall meet all the requirements of Part 6 of ICEA S-61-402.

B. Conformance Certificate and Quality Assurance Release: Submit a conformance certificate signed by the person responsible for product quality. The certificate shall specifically identify the purchased material or equipment; such as by the project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. The certificate shall indicate that requirements have been met and identify any approved deviations.

1.5 DELIVERY, STORAGE AND HANDLING

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.

PART 2 P R O D U C T S

2.1 ACCEPTABLE MANUFACTURERS

A. American Insulated Wire Corporation

B. Carol Cable Company, Inc.

C. General Cable Company

D. Okonite Company

E. Rome Cable Company

F. Triangle Wire and Cable, Inc.

2.2 MATERIALS AND EQUIPMENT

A. Design. 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 above ground in conduit or in control panels.

B. Power and control cables installed in underground situations require the use of Type CO cable as manufactured by Draka.

C. Conductors. Provide conductors which are Class B, concentric stranded, annealed uncoated copper with physical and electrical properties complying with ASTM B 3 and ASTM B 8 and Part 2 of ICEA S-61-402.

D. Insulation. 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 Table 310-13 of the National Electrical Code (NEC) for type THHN and THWN wire.

A. Wire Marking

1. Wire marking shall be in accordance with National Electrical Code (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.

B. The single conductor color coding shall be as follows:

System Voltage	A	B	C	Neutral
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			

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Complete the cable raceway systems and underground duct banks before installing cables.

B. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

C. Check the length of the cable raceway system against the length of cable on the selected reel.

D. Clean conduits of foreign matter before cables are pulled.

3.2 INSTALLATION

A. Wiring Methods

1. Use wiring methods indicated on Drawings.

2. In general, use THHN/THWN or XHHW building wire for lighting, power and control wiring where conductors are enclosed in raceways in above ground conduit system. Use Type CO wire for all installations in underground conduit banks.

3. Do not use solid conductors.

4. Use conductors not smaller than No. 12 AWG stranded for lighting circuits.

5. Use conductors not smaller than No. 14 AWG for control circuits, except when part of a multiconductor cable or internal panel wiring.

6. Do not splice conductors unless approved by the Owner's Representative.

7. Splices associated with taps for lighting and control circuits are allowed without approval as long as they are above elevation 12 MSL.

8. Make splices only in accessible junction boxes.

9. Use wire nuts with insulated caps for lighting wiring splices.

B. Single Conductor in Conduit and Ductbank

1. Install cables in accordance with the manufacturer's instructions and the National Electrical Code (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 wire pulling compounds approved by cable manufacturers to reduce friction. Lubricants must not be harmful to the conductor insulation. Mixtures containing soap or detergent shall not be used.

C. Single Conductor in Cable Tray. Do not install single conductor building wire and cable in cable tray.

D. 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.

E. Tests

1. In general, megger test insulation integrity of the wiring system before terminating. All testing results shall be submitted for approval.

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.

F. Termination. After the 600-volt wiring system has been tested with satisfactory results, reconnect wire.

END OF SECTION

Section 16126

INSTRUMENTATION CABLE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for instrumentation cable.

1.02 REFERENCES

A. 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.

B. 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.

C. Insulated Cable Engineers Association (ICEA).

1. ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).

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).

D. Underwriters' Laboratories (UL).

1. UL 44: Rubber Insulated Wires and Cables.

2. UL 83: Thermoplastic Insulated Wire and Cables.

E. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Chapter No. 3 - Wiring Methods and Materials, Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits.

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Submittal Procedures:

1. Completed engineer's data sheets from this specification or manufacturer's data sheets, cut sheets, and catalog data.

2. Installation, terminating and splicing procedure (including bending radius and pulling tension data).

3. Instruction for handling and storage.

4. Dimensions and weight.

1.04 QUALITY ASSURANCE

A. Tests

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. Refer to data sheet for additional test requirements.

Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.05 DELIVERY, STORAGE AND HANDLING

Ship 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. Reels shall be of the type specified on the data sheets. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

Alpha Wire Corporation

Belden Division, Cooper Industries, Inc.

Cablec Continental Cables Company

General Cable Company

Manhattan Electric Cable Corporation

Okonite Company

2.02 MATERIALS AND EQUIPMENT

A. Design. 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 on the Instrumentation Cable Data Sheets 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 on the Instrumentation Cable Data Sheets. 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 on the Instrumentation Cable Data Sheets.

B. Conductors. Provide conductors which are Class B, concentric stranded, annealed tinned copper whose physical and electrical properties comply with ASTM B3, B8 or B33 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516, unless otherwise specified on the Instrumentation Cable Data Sheets.

C. Insulation. Each conductor shall be insulated as specified on the Instrumentation Cable Data Sheets in compliance the requirements of Part 3 of ICEA S-61-402, S-66-524, or S-68-516. 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 on the Instrumentation Cable Data Sheets. The minimum insulation thickness shall not be less than 90 percent of the value given in the table.

D. Drain Wire. Provide drain wire which is Class B, seven-stranded, tin-coated copper in accordance with ASTM B3, B8, or B33 and as specified on the Instrumentation Cable Data Sheets. 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.

E. Shielding. Provide shielding consisting of laminated, nonburning, 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 on the Instrumentation Cable Data Sheet. Wrap the tape around each twisted pair or triad with a 25 percent minimum overlap unless otherwise specified on the Instrumentation Cable Data Sheets.

F. Jacket. The physical and electrical properties of the jacket used to cover single or multi-pair 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 is specified on the Instrumentation Cable Data Sheets. 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. The jacket material is specified on the Instrumentation Cable Data Sheets. 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. 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 on the Instrumentation Cable Data Sheets.

H. Conductor Identification. Use individual conductors in single-pair and single-triad cables which are color coded black and white; and black, white and red, respectively. Multi-pair-triad 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 S-66-524, and as specified on the Instrumentation Cable Data Sheets.

I. Cable Marking. 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. See the Instrumentation Cable Data Sheets for the minimum information required.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Complete cable raceway systems, underground duct banks and cable support systems before installing cables.

B. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

C. Check the length of the cable raceway system against the length of cable on the selected reel.

D. Do not install or work on PVC insulated or jacketed cables in temperatures below 32 degrees F.

E. Clean conduits of foreign matter before cables are pulled.

F. Provide at least 30 percent spare conductors or pairs.

3.02 INSTALLATION

A. Cable in Conduit and Ductbank

1. Install cables in accordance with the manufacturer's instructions and NEC Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling and Power Limited Circuits. 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 or cable jacket.

3. Conduits carrying low level signal cables shall be PVC-coated rigid steel.

B. Cable in Tray. Install instrument and signal cable in cable tray only when the tray is dedicated for this type cable and cables are approved for tray installation.

C. Termination

1. Do not splice conductors. For termination use crimp-on type ring tongue non-insulated tin plated copper lugs.

2. 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.

3. 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.

4. 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.

D. Tests

1. Before connecting the cables, test insulation integrity and conductor continuity.

2. Use a 500 VDC megohmmeter and perform the cable insulation test in accordance with the operating instructions.

E. Termination. After the 600-volt cable has been tested with satisfactory results, the cable can be terminated at both ends to their designated terminal points.

END OF SECTION

Section 16131

DEVICE, PULL, JUNCTION, AND TERMINAL
BOXES AND WIREWAYS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for device, pull, terminal and junction boxes and wireways.

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 370 - 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. Submit the following under provisions of Section 01300 – Submittal Procedures:

1. Manufacturer's cut sheets, catalog data

2. Instruction for handling and storage

3. Installation instructions

4. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

A. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Sheet Metal Boxes

1. Hoffman Industrial Products

2. Pauluhn Electric Manufacturing Company

3. Hennessy

4. Tanco

5. Tejas

6. Circle A.W.

2.02 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes

1. Provide UL-approved junction and pull boxes and wireways manufactured from Type 316 stainless steel sheet metal and meeting requirements of NEMA 4X for all areas.

2. Provide enclosures with a stainless steel continuous hinge, spring loaded closure hasps and all-stainless steel hardware. All seams shall be welded and ground smooth. No sealant of any nature may be used to achieve compliance.

3. Furnish the door with neoprene gasket and provision for padlock.

B. Hardware

1. Mounting Hardware: 316 stainless steel

2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal. All such conduit connections to sheet metal enclosures of any nature shall be equipped with such hubs. All such hubs shall be equipped with auxiliary grounding lugs that are securely interconnected to the facility grounding system.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. 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. Install boxes in accordance with NEC Article 370 in locations indicated on the Drawings.

C. Install all 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. Label boxes with phenolic nameplates attached with stainless steel screws.

END OF SECTION

SECTION 16135

CABINETS, BOXES AND FITTINGS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of the following:

1. Outlet and device boxes.
2. Pull and junction boxes.
3. Floor boxes and service fittings.
4. Cabinets.
5. Hinged door enclosures.
6. Boxes and fittings for hazardous locations.

B. Conduit-body-type electrical enclosures and wiring fittings are specified in Section 16111, Conduit, Fittings, and Bodies.

C. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM): ASTM A167- Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

B. Underwriter's Laboratory (UL):

1. UL 50 - UL Standard for Safety Cabinets and Boxes.
2. UL 514A - UL Standard for Safety Metallic Outlet Boxes.
3. UL 514B - UL Standard for Safety Fittings for Conduit and Outlet Boxes.
4. UL 886 - UL Standard for Safety Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

C. National Electrical Manufacturer's Association (NEMA):

1. NEMA ICS 6 - Enclosures for Industrial Control and Systems.
2. NEMA OS 1- Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
3. NEMA 250 - Enclosure for Electrical Equipment (1,000V maximum).

1.3 DEFINITIONS

A. Cabinets: Enclosure designed either for surface or for flush mounting and having frame or trim in which door or doors may be mounted.

B. Device Box: Outlet box designed to house receptacle device or wiring box designed to house switch.

C. Enclosure: Box, case, cabinet, or housing for electrical wiring or components.

D. Hinged Door Enclosure: Enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with walls of box.

E. Outlet Box: Wiring enclosure where current is taken from wiring system to supply utilization equipment.

F. Wiring Box: Enclosure designed to provide access to wiring systems or for mounting of indicating devices or of switches for controlling electrical circuits.

1.4 SUBMITTALS

A. Provide submittals in accordance with Section 01300, Submittals.

B. Submit all products covered under this specification for Engineer's approval.

C. Product Data: Submit for cabinets and enclosures with classification higher than NEMA 1.

D. Shop Drawings: Submit to Engineer for approval.

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.

1.5 QUALITY ASSURANCE

A. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.

PART 2 - P R O D U C T S

2.1 CABINETS, BOXES, AND FITTINGS, GENERAL

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for use and location. Provide items complete with covers and accessories required for intended use. Provide gaskets for units in damp or wet locations.

B. Cabinet and Enclosures Heights: Cabinet, panel, and enclosure heights shall not exceed 6 feet – 6 inches from floor to top fastening devices to allow access by Operator without use of ladders or steps to open enclosure doors.

2.2 MISCELLANEOUS MATERIALS AND FINISHES

A. Fasteners for General Use: Stainless steel screws and hardware.

B. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

C. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Stainless steel for conduit hubs, bushings, and box connectors.

D. Finishes:

1. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.
2. Interior Finish: Where indicated, white baked enamel.

2.3 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

A. General:

1. Conform to UL 514A and UL 514B.
2. Boxes shall be of type, shape, size, and depth to suit each location and application.

B. Steel Boxes: Conform to NEMA OS 1. Boxes shall be sheet stainless steel with stamped knockouts, threaded screw holes, and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

2.4 PULL AND JUNCTION BOXES

A. General: Comply with UL 50 for boxes over 100 cu in. volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. Stainless-Steel Boxes: Fabricate of 316 stainless steel conforming to ASTM A167. Where necessary to provide rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.

C. Boxes Approved for Classified Locations: Cast metal or cast nonmetallic boxes conforming to UL 886 listed and labeled for use in specific location classification, and with specific hazardous material encountered. Conduit entrances shall be integral threaded type.

2.5 CABINETS

A. Acceptable Manufacturers

1. Hennessey Products, Inc.
2. NEMACO Technology
3. Hoffman Engineering
4. The EMF Company
5. Rose Enclosure
6. Weigman Company
7. NEMA Enclosures Manufacturing
8. Or, equal quality Manufacturer.

B. Indoor Control Cabinets

1. Enclosure: NEMA 250, Type 12 unless shown otherwise on plans.
2. Enclosure Size: As indicated on Drawings or, if not indicated, as required to mount equipment indicated to UL Standards.
3. Backboard for Mounting Terminal Blocks, Components, and Inner Door: 12 gauge stainless steel, finished in white enamel.
4. Fronts: Stainless steel pan-type doors with concealed stainless steel piano hinges, held closed by stainless steel 3-point latch operable by pistol grip handle.

5. Provide solid metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
6. Clean surfaces to remove dirt and corrosion residue. Phosphatize for corrosion protection. Prime with two coats, and finish with one coat, of factory-applied textured polyurethane, minimum 5 mils thickness, color as selected by City Engineer from manufacturer's standard colors.
7. Panel Construction: Provide panel stiffeners and bracing. Fully gasket doors. Weld seams and grind smooth.
8. Conduit Entrances: Bottom entry unless otherwise indicated on Drawings.
9. Material: Minimum 12 gauge stainless steel.
10. Finish: Enamel; gray outside, white inside.
11. Provide thermostat controlled strip-type space heater (150 watts maximum), convenience outlets and internal LED lighting (where shown on drawings.)
12. Nameplates: On the outside of each cabinet's inner door, provide motor data nameplate information for each pump motor; copy all information exactly as shown on each motor nameplate. Provide engraved laminated plastic nameplates; black letters with white background; fasten to outside of cabinet door of each motor starter section with stainless steel screws.
13. Install wiring in open-slot plastic wiring duct.
14. On indoor panels, install a 4-inch passive vent in the side near the top and near the bottom of an adjacent side panel. These vents shall have removable filters to resist dust and insect entry.

C. Outdoor Control Cabinets

1. Enclosures: NEMA 4X 316 stainless steel, or as shown on drawings.
2. Enclosure Size: As indicated on Drawings, or if not indicated, as required to accommodate equipment and as indicated in UL standards.
3. Material: Exterior and interior enclosure doors, shelves and component enclosures: Fabricate of 14 gauge type 316 stainless steel.
4. Doors: Stainless steel pan-type construction, with full-length stainless steel piano hinge. Equip exterior door with locking hasp, padlock, heavy-duty locking pistol-grip handles, door restraint and 3-point latching mechanism of the draw roller type (0.750 inch minimum diameter rollers). Handles shall be 3/4 inch minimum diameter stainless steel. Equip interior doors with flush quarter-turn closure devices. Equip interior and exterior doors with neoprene gaskets. Provide restraints on all outer doors.
5. Space Heaters: Provide minimum 150 watt strip-type space heaters with an individual thermostat in each section. Use heaters rated for 240V, producing the required wattage when operated at 120V.
6. Provide rain shield with 1 inch drip lip for outdoor cabinets to protect against direct sun radiation and rainfall. Design shield to provide 1 foot of cover front and back and 2 inches of cover on the sides. Design shield to provide no more than 1 foot peak height above the top of the panel with 1 inch airflow clearance from the top of the control panel. Shielding material: Type 316 stainless steel.
7. Nameplates: On the outside of each cabinet's inner door, provide motor data nameplate information for each pump motor; copy all information exactly as shown on each motor nameplate. Provide engraved laminated plastic nameplates; black letters with white background; fasten to outside of cabinet door of each motor starter section with stainless steel screws.
8. In each cabinet section, provide a 120V convenience outlet and a switched 40 watt minimum LED light fixture, with 0 degrees F ballast in each section (where shown on plans.)
9. Inside and outside of cabinet shall be smooth and free from burrs.
10. NEMA 4X enclosures shall have all boltholes gasketed.
11. A divider of same material and thickness as the cabinet shall be added to divide electrical components and wiring from instrumentation and pneumatic components and wiring.
12. No control devices are allowed on outer door of outdoor enclosures.
13. NEMA 6P enclosures shall be suitable for subversion to 20 feet.
14. Where NEMA 6P enclosures are shown on drawings, a NEMA 6P outer enclosure shall be provided, with a NEMA 4X internal door, or separate enclosure inside that will be fully encased in the 6P enclosure. It is expected that the Owner will store the 6P covers, and utilize the 4X enclosure to gain access for daily logging, maintenance, etc.; 6P covers will be installed in preparation for a high-water event. Provide all attaching bolts (+10% spare) and gaskets at final inspection for delivery to the City.

D. Clear plastic outer or inner doors are not acceptable unless specifically noted on plans.

PART 3 - E X E C U T I O N

3.1 INSTALLATION, GENERAL

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Sizes shall be adequate to meet current NEC volume requirements, but in no case smaller than sizes indicated.

D. Remove sharp edges where they may come in contact with wiring or personnel.

3.2 APPLICATIONS

A. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types for each location in conformance with following requirements unless otherwise noted:

1. Wet Locations: 316 Stainless Steel, NEMA type 4X enclosures, except where shown otherwise on drawings.
2. Corrosive Locations: 316 Stainless Steel, NEMA type 4X enclosures, except where shown otherwise on drawings.
3. Low Elevation Locations: 316 Stainless Steel, NEMA type 6P enclosures, except where shown otherwise on drawings. Critical elevations are shown on civil drawings. Contact Engineer where questions arise to ensure proper application.

B. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location.

3.3 INSTALLATION OF OUTLET BOXES

A. Gasketed Boxes: At following locations use stainless steel, threaded hub type boxes with gasketed weatherproof covers:

1. Exterior locations.
2. Where exposed to moisture laden atmosphere.
3. Where indicated.

B. Mounting: Mount outlet boxes for switches with long axis vertical or as indicated. Mount boxes for receptacles vertically. Gang boxes shall be mounted with long axis horizontal.

C. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

D. Set boxes in concealed conduit runs, flush with wall surfaces, with or without covers as required.

E. Set outlet boxes parallel to construction, securely mounted and adjusted to set true and flush with finished surface.

F. Provide outlet box divider barriers between 277/480 v and 120/240 v devices as required and per current NEC.

3.4 OUTLET BOX LOCATIONS

A. Locate flush mounted wall boxes in corner of nearest brick or block to keep cutting to minimum.

B. Location of outlets and equipment as shown on Drawings is approximate and exact location to be verified and shall be determined by:

1. Construction or code requirements.
2. Conflict with equipment or other trades.
3. Equipment manufacturer's drawings.

C. Minor modification in location of outlets and equipment considered incidental up to distance of 10 ft with no additional compensation, provided necessary instructions given prior to roughing in of outlet.

D. Mounting heights for devices and equipment to be measured from finished floor to centerline of device unless otherwise noted on Drawings.

3.5 INSTALLATION OF PULL AND JUNCTION BOXES

A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8-in. square by 4-in. deep. Do not exceed six (6) entering and six (6) leaving raceways in single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed following:

Size of Largest Conductors in Box	Maximum No. of Conductors in Box
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

1. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 in. inside boxes.
2. Size: Provide pull and junction boxes for telephone, signal, instrumentation, control, and other systems at least 50% larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.6 GROUNDING

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes grounding conductor, provide grounding terminal in interior of cabinet, box, or enclosure.

B. Ground in accordance with Section 16452 – Grounding.

3.7 CLEANING AND FINISH REPAIR

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions, and weld marks.

B. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION

Section 16140

WIRING DEVICES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for wiring devices including:

1. Receptacles.

2. Wall switches.

3. Wall plates and cover plates.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):

1. NEMA WD1 - General Purpose Wiring Devices.

2. NEMA WD6 - Dimensional Requirements.

B. Federal Specifications (WC-596F).

C. American National Standards Institute/National Fire Protection Association (NFPA):

1. NFPA No. 70 - National Electrical Code (NEC), Articles 210 Branch Circuits, 250 Grounding and 410, Paragraphs 56, 57 and 58.

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Product Data: Manufacturer's product literature and specifications including dimensions, weights, certifications and instructions for handling, storage and installation.

1.04 DELIVERY, STORAGE AND HANDLING

A. Pack and crate devices to permit ease of handling and protect from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Bryant Electric

B. Crouse-Hinds, Arrow Hart Division

C. Hubbel Inc. Wiring Devices Division

D. Leviton Manufacturing Company

E. Pass & Seymour/Legrand.

2.02 MATERIALS AND EQUIPMENT

A. Standards: Conform to NEMA WD1 for general requirements and NEMA WD6 for dimensional requirements.

B. Manufacture devices to heavy-duty industrial specification grade with brown nylon bodies (orange for isolated-ground receptacles) back and side wiring provisions and green-colored grounding screws.

C. Receptacles:

1. Duplex-type receptacles: Rated 20 amps at 120 volts.

2. Contacts: Brass or phosphor bronze.

3. Receptacle grounding system: Extend to the mounting strap unless isolated ground is indicated or required.

4. GFI or GFCI (ground fault circuit interrupter) receptacles: Provide feed-through type with test and reset button.

D. Wall Switches:

1. Toggle switches: Rated 20 amps at 120/277 volts AC rated for both resistive and inductive loads.
2. Contacts: Silver cadmium oxide construction to prevent sticking, welding and excessive pitting.

E. Cover Plates:

1. In outdoor, corrosive and wet areas, provide cover plates of cast metal, gasketed with spring-loaded hinged covers and stainless steel hardware.

2. All other plates: Type 316 stainless steel.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify that device boxes are correctly placed.

B. Verify that the correct quantity, size and type of wires are pulled to each device box.

C. Verify that wiring has been checked at both ends.

D. Prepare wire ends for connection to devices.

E. Inspect each wiring device for defects.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on top.

E. Connect wiring device grounding terminal to outlet box with bonding jumper.

F. Connect wiring devices by wrapping conductors clockwise around screw terminals.

G. Install cover plates on switch, receptacle and blank outlets in finished areas.

H. Energize and test devices for proper operation.

END OF SECTION

Section 16160

CABINETS AND ENCLOSURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for cabinets and enclosures for housing of control panels, motor controls and related electrical components.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA).

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 373 - Cabinets, Cutout Box, and Meter Socket Enclosures.

C. Underwriters Laboratories (UL), UL 50 - Safety for Cabinets and Boxes.

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01300 – Submittal Procedures:

1. Manufacturer's cut sheets and catalog data

2. Instruction for handling and storage

3. Installation instructions

4. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

A. Have cabinets and enclosures packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. The EMF Company

B. Hennessey Products, Inc.

C. Hoffman Industrial Products

D. Pauluhn Electric Manufacturing Company

E. Weigman Company

F. Rose Enclosure

G. N.E.M.A. Enclosure Mfg. Co.

2.02 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes

1. Provide enclosures manufactured in accordance with NEMA 250 and NEC Article 373. Fabricate outdoor NEMA 4X enclosures from minimum 14 gauge, 316 stainless steel for all areas. Additional white painted coatings shall be provided for the main control panel and any other enclosures which contain electrical components that could be damaged by excessive heat.

2. Dimensions and special features are shown on the Drawings.

3. Construct outdoor enclosures with continuously welded seams ground smooth. No sealants of any nature may be used.

4. Additional material thickness and bracing requirements shall be determined by the manufacturer to provide the strength required by the standard listed. The bracing shall be provided in such a way as to minimize the protrusion into the wiring and the equipment spaces.

5. Install the door with a stainless steel continuous hinge, stainless steel padlock handle with gasket and stainless steel hardware.

6. Furnish the door with oil-resistant neoprene gasket attached with oil-resistant adhesive and held in place with aluminum retaining strips.

7. For large enclosures provide a single, 3/4-inch minimum, door handle that provides a 3-point latching through latch rods with rollers. Provide rollers with at least 3/4-inch diameter.

8. Gasketed overlapping doors may be used instead of a center post.

9. Provide heavy duty lifting eyes of suitable material.

10. Fabricate the enclosure with a stud-mounted panel inside. Make panels from 12-gauge steel painted with white enamel finish.

11. Weld mounting feet to the enclosure if called for on the Drawing.

12. Include a high impact plastic data pocket in the enclosure.

13. Provide ground connections on the enclosures to enable grounding of the enclosure with a No. 2 AWG conductor.

14. Equip free-standing outdoor cabinets with inner and outer door restraint bars to prevent door swing during windy conditions.

B. Hardware

1. Mounting Hardware: 316 stainless steel

2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal. Provide hubs of this nature for conduit connections to all enclosures. All such hubs shall be equipped with an auxiliary grounding lug that is securely connected to the facility grounding grid.

2.03 TESTING

A. Test cabinets and enclosures in accordance with UL requirements so unit qualifies for a UL label.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Review Drawings and determine how many enclosures of each kind are required and check if supplied quantity is sufficient.

B. Check the mounting pads or foundations for proper mounting dimensions and features, including grounding conductor stub-up.

3.02 INSTALLATION

A. Use enclosures described in this specification only above grade.

B. Install enclosures in accordance with the NEC in locations as indicated on the Drawings.

C. Install enclosures in readily accessible locations to facilitate general operations, wire pulls, maintenance and repair.

D. Plug unused conduit openings.

E. Make conduit connections to the enclosures with watertight conduit connectors.

F. Identify all components in cabinets with phenolic nameplates.

G. Use pre-printed tubular heat-shrink type wire and cable markers to label each end of all conductors.

END OF SECTION

Section 16170

GROUNDING AND BONDING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Grounding electrodes and conductors

B. Equipment grounding conductors

C. Bonding

D. Power system grounding

E. Communication system grounding

F. Electrical equipment and raceway grounding and bonding

G. Control equipment grounding

1.02 REFERENCES

A. 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

B. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 142-82: Recommended Practice for Grounding of Industrial and Commercial Power Systems

2. IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

C. Underwriters' Laboratories (UL)

1. UL 83: Thermoplastic Insulated Wire and Cables

2. UL 467: Grounding and Bonding Equipment

D. National Fire Protection Association (NFPA), NFPA No. 70 - National Electrical Code (NEC), Article No. 250 - Grounding.

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01300 – Submittal Procedures:

1. Manufacturer's cut sheets and catalog data

2. Installation, terminating and splicing procedure

3. Instruction for handling and storage

4. Dimensions and weight

1.04 QUALITY ASSURANCE

A. Tests

1. Use insulated cable conforming to requirements of the vertical tray flame test as described in IEEE 383-2.5.

2. Test grounding system in the field in accordance with procedures outlined in Part 3 - Execution.

1.05 DELIVERY, STORAGE AND HANDLING

A. Ship grounding 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. Pack and crate other materials specified to withstand normal abuse during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Cable

1. American Insulated Wire Company
2. Cablec Continental Cables Company
3. General Cable Company
4. Okonite Company
5. Pirelli Cable Corporation
6. Rome Cable Corporation
7. Triangle Wire and Cable, Inc.

B. Ground Rods and Connectors:

1. Blackburn
2. Copperweld
3. Thomas & Betts

C. Exothermic Connections:

1. Burndy Corporation (Therm-O-Weld)
2. Erico Products (Cadweld)

D. Grounding Connectors:

1. Burndy Corporation
2. O.Z. Gedney
3. Thomas & Betts

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide grounding cable and materials with the following characteristics:

1. Use a grounding system designed in accordance with NEC Article No. 250 - Grounding, and the IEEE 142-82 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

B. Materials

1. Use grounding conductors, bare underground and insulated above ground, which are manufactured and tested in accordance with applicable standards ASTM B3, ASTM B8 and ASTM B33.

2. Provide a main ground loop of No. 4/0 AWG, Class C stranded, bare copper cable. Small groups of isolated equipment may be grounded by a No. 2 AWG minimum insulated conductor connected to the main loop. Generally, taps shall be sized as follows:

a.	Main ground loop or grid	#4/0 minimum
b.	Switchgear, motor control centers and power transformers	#4/0
c.	Motors 200 hp and above	#4/0
d.	Power panels - AC and DC	#2/0
e.	Control panels and consoles	#2
f.	Building columns	#4/0
g.	Fencing posts	#2/0

3. Where single conductor insulated grounding conductors are called for use 600-volt insulation. Use ground conductors identified with green insulation. The use of green insulating tape is not permitted.

4. Supply identifying ribbon which is PVC tape, 3 inches wide, red color, permanently imprinted with "CAUTION BURIED ELECTRIC LINE BELOW" in black letters as specified in Section 16195, Electrical Identification.

5. Utilize flexible copper braid across hinged chain link or fence gates to bond the movable portion to the grounded fence post.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Complete site preparation and soil compaction before trenching and driving ground rods for the underground grid.

B. Verify from Drawings the exact location of stub-up points for grounding of equipment, fences and building or steel structures.

3.02 CONSTRUCTION CRITERIA

A. The main ground loop at a depth of at least 30 inches below earth surface. Connect the ground loop to ground rods and to tap connections to form a complete system as indicated on the electrical Drawings. The Contractor shall give special attention to the grounding of service equipment, structures and fences to comply with the NEC, local authorities and the serving utility company.

B. All electrical equipment, buildings, tanks, and equipment shall be grounded. Where ground rods are required, the rods shall be 10 feet long, 3/4 inch diameter, copper-clad steel ground rods. Rods shall be driven vertically, and the top of the rods shall be a minimum of 18 inches below finished grade, or as specified on the Drawings. All ground rods shall be installed in specifically designed precast concrete ground rod wells that are equipped with a metal cover with the designation of GROUND on the cover.

C. Local pushbutton and selector switch stations, two-wire control devices, disconnect switches, lighting transformers, panel boards, operator panels, bench boards, and the enclosures of other electrical apparatus shall be grounded through a power grounding conductor routing with the power conductors in the conduit and a supplemental equipment grounding conductor run independently.

D. Motors having power supplied by multi-conductor cable shall be grounded by a separate grounding conductor in the cable and where supplied by single conductor cable in conduit by a grounding conductor pulled in the conduit. Connect ground conductors to the ground bus in the motor control center and to the ground terminal provided in the motor conduit box.

E. Do not ground the insulated bearing pedestals of large motors.

F. Connect ladder-type cable trays to the grounding electrode system.

G. Install a warning ribbon approximately 12 inches below finished grade directly above the ground grid.

H. Connect fence posts of chain link and metal fences to the main ground loop at least every 50 feet.

3.03 INSTALLATION

A. Equipment Grounding

1. Make grounding connections to surfaces which are dry and cleaned of paint, rust, oxides, scales, grease and dirt to ensure good conductivity. Clean copper and galvanized steel to remove oxide before making welds or connections.

2. Use the exothermic welding process for below-grade grounding connections, except at ground rods. Use mechanical connectors or thermal connections for above-grade grounding connections as shown on the Drawings.

3. Make grounding connections to electrical equipment, vessels, mechanical equipment and ground rods in accordance with the Drawings.

4. Ground tanks and vessels by making connections to integral structural supports or to existing grounding lugs or pads, and not to the body of the tank or vessel.

5. Leave ground connections to equipment visible for inspection. Protect them with PVC non-metallic conduit as indicated on the Drawings.

6. Make connections to motor frames and ground buses with lugs attached to the equipment by means of bolts. Do not use motor anchor bolts or equipment housing for fastening lugs of grounding cable.

7. Where the wiring for lighting systems consists of single conductor cables in conduit, provide each conduit with an equipment grounding conductor. Use a grounding conductor with green colored insulation and ground equipment in the lighting system.

B. Raceway and Support Systems Grounding

1. Install raceway, cable rack or tray and conduit so that it is bonded together and permanently grounded to the equipment ground bus, according to the Drawings. Connection to conduit may be grounding bushing or ground clamp.

2. Install raceway at low voltage motor control centers or other low voltage control equipment so that it is bonded and grounded, except that any conduit which is effectively grounded to the sheet metal enclosure by bonding bushing or hubs need not be otherwise bonded.

3. Where grounding conductors are run in or on a cable tray, bond the grounding conductor to each section of cable tray with a cable tray ground clamp.

4. Where only grounding conductor is installed in a metal conduit, bond both ends of the conduit to the grounding conductor.

5. Provide flexible "jumpers" around raceway expansion joints. Use copper bonding straps for steel conduit. Install jumpers across cable tray joints which have been parted to allow for expansion and any hinged cable tray connections.

C. Fences and Gates. Ground fences, fence posts and gates to the underground grid as noted in these specification and as shown on the Drawings.

D. Power System Grounding

1. Solidly ground the secondary neutral of the main power supply transformer either to the ground grid. See Drawings for additional details.

2. Solidly ground the neutral of lighting, instrument and control transformers.

E. Cable Armor and Shields

1. For shielded control cable, terminate and ground the shield at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Maintain shield continuity by jumping the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground.

2. Connect the ground wire in power cable assemblies at each terminal point to a ground bus, if available, or to the equipment enclosure. Do not carry these ground wires through a "doughnut" current transformer (CT) used for ground fault relaying; do carry ground leads from stress cones through CTs. Ground power cable armor and shield at each terminal point.

F. Test Wells

1. Provide access (test wells) for testing the ground grid system at one or several ground rod locations. Make test wells of a pipe surrounding the rod and connections with a cover placed on top at grade level. See Drawings for details.

2. Install a test well at the service entrance pole to serve as the service entrance grounding electrode.

G. Test

1. Perform ground resistance tests after underground installation and connections to building steel are complete, unless otherwise noted on applicable Drawings.

2. Make tests at each and every ground tap using a "fall of potential" test method. Each ground tap test shall not exceed a maximum resistance of 3 ohms. Where measured values exceed this figure, install additional ground rods as required to reduce the resistance to the specified limit. Submit the results of all grounding testing for review and approval. All such grounding testing results shall be

submitted with a drawing that illustrates the specific location of each grounding test conducted.

H. Inspection. Inspection of the grounding system by the Engineer and the local Code Inspector must take place before the grid trenches are backfilled.

END OF SECTION

Section 16195

ELECTRICAL IDENTIFICATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specification for electrical identification including:

1. Nameplates and labels
2. Wire and cable markers
3. Conduit markers
4. Cable tray markers
5. Underground warning tape
6. Warning labels

1.02 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

1. No. 70 - National Electrical Code (NEC)

a. Article 110 - Requirements for Electrical Installation

b. Article 430 - Transformers and Transformer Vaults

B. City of Galveston Building Code

C. Other applicable Codes and Standards as referenced in other Sections.

D. Underwriters Laboratories. U.L. Standards No. 224 - Extruded Insulated Tubing

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01300 Submittal Procedure:

1. Manufacturer's cut sheets and catalog data
2. Description of materials used
3. Label or nameplate dimensions
4. Engraving or imprint legends
5. Instruction for handling and storage
6. Installation instructions

1.04 DELIVERY, STORAGE AND HANDLING

A. Pack materials to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Almetek Industries Incorporated

B. Brady U.S.A. Incorporated

C. Ideal Electric Company

D. Raychem Corporation

E. 3M Electrical Products Division

F. Thomas & Bett

G. Tyton Corporation

2.02 MATERIALS AND EQUIPMENT

A. Nameplates and Labels

1. Provide an identification tag for each item of electrical equipment showing its item number and service or application. Use the description shown on the electrical Drawings.

2. For nameplates, use 3-ply phenolic material engraved to show black lettering on a white background. Size the nameplates approximately 1 inch wide and 3 inches long for 3 lines of 3/16 inch - 16 letters with a 0.8 condensed factor.

3. Generally, provide large pieces of equipment with engraved nameplates; provide additional nameplates at pushbuttons and other local devices; as detailed. Provide identification for all other electrical equipment, devices, or enclosures, such as MCC's, panel boards, disconnect switches, capacitors, relays, and dedicated receptacles not furnished with readily noticeable tag, nameplates, or other means of identification.

4. Install nameplates on the front cover of transformers stating the transformer service location number or identification number, the panel board or device served, and main breaker feeding the transformer (MCC No. and compartment), and the drawing number on which the transformer schematic is shown.

5. Furnish equipment, such as motor starters, safety switches, welding receptacles and circuit breakers, with 1" x 3" plastic nameplates stating description of item served.

6. Provide nameplates for motors giving the driven equipment description, the service location number, and the MCC number with compartment number when applicable. Nameplates will normally be mounted adjacent to the motor at the motor pushbutton when one is furnished.

7. Install nameplates on the outside and inside of doors to circuit breaker panel boards (i.e., lighting, instrument or receptacle panels). State the panel board name, the drawing number on which the panel board schedule shows, and the main breaker feeding the panel (MCC No. and compartment).

8. Type panel board directories and insert them inside the panel board doors.

9. Place a large nameplate approximately 3"x5" on control panels, relay panels, junction boxes, or enclosures with electrical devices mounted inside or on the outside of the enclosure indicating the purpose of the cabinet.

10. Provide a nameplate on MCC motor starter doors duplicating motor nameplate data.

B. Wire and Cable Markers

1. Use pre-printed tubular heat-shrink type wire and cable markers at each end of all conductors..

2. Select markers manufactured so that the heat-shrink process makes the imprint permanent and solvent-resistant.

3. Use markers that are self-extinguishing, conforming to U.L. Standard No. 224 for print performance, heat shock, and flammability.

4. Provide marker material that is flexible, radiation cross-linked polyolefin with 3 to 1 shrink ratio, rated 600 volts, and white in color.

C. Conduit Markers

1. Provide conduit markers made of stainless steel tags approximately 2 inches x 1 inch x 19 gage.

2. Stamp the caption on the tag and have it black filled.

3. Punch tags for tie fasteners. Fasten tags to the conduits with stainless steel cable ties as manufactured by Panduit or approved equal.

D. Cable Tray Markers

1. For high visibility and contrast, use cable tray markers that are yellow with black legend.

2. Use markers made of vinyl impregnated cloth, suitable for exposure to corrosive, wet, and abrasive environment.

3. Make markers of pre-cut individual letters or numbers with pressure sensitive adhesive backing.

4. Size legend characters to 4 inches high on a total marker height of approximately 5 inches, suitable for applying to 6-inch side rails of a cable tray.

E. Underground Warning Tape

1. Provide warning tape made of 4 mil thick polyolefin film, 3 inches wide, suitable for direct burial and resistant to alkalis, acids, and other common soil substances.

2. Use red tape with black legend printed in permanent ink.

F. Warning Labels

1. Place OSHA safety labels on enclosures and boxes 100 cubic inches or more

containing electrical equipment or terminations.

2. Provide OSHA color codes for the labels. Use labels made from 4 mil vinyl with pressure sensitive adhesive backing.

3. The warning label caption is DANGER - 480 VOLTS or as indicated on the Drawings

4. Size labels either 5 inches x 3-1/2 inches or 10 inches x 7 inches, as indicated on the Drawings.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Degrease and clean surfaces where adhesive labels will be applied.

B. Drill holes for nameplates to be fastened with stainless screws.

C. Prepare the cable ends for termination and conductor markings.

D. Identify conduits at terminating points and select tags accordingly.

3.02 INSTALLATION

A. Install nameplates and labels in accordance with the manufacturer's instructions and the Drawings.

B. Apply wire and cable markers in accordance with manufacturer's instructions using a heat gun with properly sized nozzle for the application. Tag the wires at both ends with the same notation.

C. Tag conduits at junction boxes, pull boxes, and at other termination points.

D. Identify cable trays at the time of installation with the alphanumeric number shown on the Drawings. Label cable trays on the outside rail. Place the tray identifier at each point where the tray designation changes and at 200 foot intervals in between, but not less than two per run.

E. Identify underground conduits, cables, or duct banks using the underground warning tape. The underground grounding grid, including the laterals. Also use underground warning tape. Install one tape per trench at 12 inches below grade or as indicated on the Drawings. For wide trenches or duct banks, install one warning tape per 24 inch width.

F. Apply the 5 inches by 3-1/2 inches warning labels to disconnect switches, panel boards, terminal boxes, and similar devices in accordance with manufacturer's instruction and the Drawings. Apply the 10 inches x 7 inches warning labels to larger control panel enclosures, motor control centers, and to entrance doors to buildings containing electrical power and control equipment.

END OF SECTION

SECTION 16290

LOW VOLTAGE SURGE PROTECTION DEVICE

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers.

B. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

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. See Section 16012, Electrical Work, paragraph entitled Submittals, for submittal requirements.

1.2 REFERENCE STANDARDS AND PUBLICATIONS

The latest edition of the following standards and publications shall comply with the work of this section:

A. ANSI/IEEE C84.1, American National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hertz)

B. ANSI/IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits

C. ANSI/IEEE C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits

D. Underwriters Laboratories-UL 1449 Third Edition, Standard for Safety - Surge Protective Devices

E. Underwriters Laboratories-UL 1283, Standard for Safety - Electromagnetic Interference Filters

F. National Fire Protection Association, NFPA 70 - National Electrical Code

G. IEEE Standard 142, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)

H. ANSI/IEEE Standard 141, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book)

I. IEEE Standard 1100, IEEE Recommended Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book)

J. National Electrical Manufacturer's Association, NEMA LS-1

K. MIL Standard 220B Method of Insertion-loss Measurement

L. ISO 9001, Quality Management Requirements

1.3 MANUFACTURER QUALIFICATIONS

A. Products manufactured by Square D Company are acceptable. Alternative, pre-approved substitutions will also be considered.

B. All surge protective devices for service entrance, distribution, and branch circuit protection within a facility shall be provided by a single manufacturer.

C. The manufacturer must be regularly engaged in the manufacture of surge suppression products for the specified categories for no less than 10 years.

D. The Manufacturer of the assembly shall be the Manufacturer of the major components within the assembly.

E. For the equipment specified herein, the Manufacturer shall be ISO 9001 or 9002 certified.

F. The Manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

G. The surge protection device shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.4 WARRANTY

A. Electrical equipment shall be warranted in accordance with the requirements of Section 01010. Contractor shall provide full 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. Included under this warranty shall be all equipment, devices, hardware, and software.

B. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh marine electrical/mechanical environment in which it is installed. Where Manufacturer's products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its affect on the product. Contractor is fully responsible for assuring that Product Manufacturers are aware of this condition and that warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor's expense and at no additional cost to the Owner.

C. 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.

D. 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.

E. A surge protection device that shows evidence of failure or incorrect operation during the warranty period shall be replaced free of charge. Since "Acts of Nature" or similar statements typically include the threat of lightning to which the surge protection devices shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this section. The warranty shall cover the replacement of complete device. Surge protection devices with warranties that are meant to repair or supply replaceable parts shall not apply to this section.

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01300, Submittals.

B. The SPD submittals shall include, but shall not be limited to, the following information:

1. Data for each suppressor type indicating conductor sizes, conductor types, and connection configuration and lead lengths
2. Manufacturer's certified test data indicating the ability of the product to meet or exceed requirements of this specification
3. Drawings, with dimensions, indicating surge protection device mounting arrangement and lead length configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies
4. List and detail all protection systems such as fuses, disconnecting means and protective materials
5. Surge protection device wiring, bonding, and grounding connections shall be indicated on the wiring diagrams for each system. Include installation details demonstrating mechanical and electrical connections to equipment to be protected
6. If requested, a sample of each suppressor type shall be submitted for use in testing and evaluation.
7. Provide verification that the surge protection device complies with the required ANSI/UL 1449, Third Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NTRL website, as long as the website contains the following information at a minimum: model number, surge protection device type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
8. For side mount mounting applications (surge protection device mounted external to electrical assembly), Electrical/Mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

C. The following information shall be submitted for record purposes: Final As-Built drawings and information for items listed above and shall incorporate all changes made during the manufacturing process.

1.6 DELIVERY, STORAGE, AND HANDLING

Equipment shall be handled and stored in accordance with Manufacturer's instructions. One (1) copy of Manufacturer's instructions shall be included with the equipment at time of shipment.

1.7 OPERATION AND MAINTENANCE (O&M) MANUALS

O&M manuals shall be provided with each surge protection device shipped.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Square D Company

B. Pre-approved substitution

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
3. The 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.
4. Protection Modes – The surge protection device must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (In) – All surge protection devices applied to the distribution system shall have a 20kA In rating regardless of their surge protection device type (includes Types 1 and 2) or operating voltage. Surge protection devices having an I_n less than 20kA shall be rejected.
6. ANSI/UL 1449 Third Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 Third Edition VPR for the device shall not exceed the following:

MODES	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. Surge Protection Device Design:

1. Maintenance Free Design – The surge protection device shall be maintenance free and shall not require any user intervention throughout its life. Surge protection devices containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. Surge protection devices requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. Surge protection devices requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. 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 surge protection device modules shall not be accepted.
3. 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 MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

5. Monitoring Diagnostics – Each surge protection device shall provide the following integral monitoring options:

a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

1) For wye-configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. Surge protection devices that indicate only the status of the L-N and L-G modes shall not be accepted.

2) For delta-configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Remote Status Monitor – The surge protection device must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

c. Audible Alarm and Silence Button – The surge protection device shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

d. Surge Counter – The surge protection device shall be equipped with an LCD display that indicates to the 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. In order 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.

1) The ongoing surge count shall be stored in non-volatile memory. If power to the surge protection device is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection: The unit shall contain thermally protected MOVs. These 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 MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the surge protection device components and diagnostics shall be contained within one discrete assembly. Surge protection devices or individual surge protection device modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements:

a. The surge protection device shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. Surge protection devices containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. Surge protection devices requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. Surge protection devices requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

b. Surge protection devices designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

c. Side mount surge protection devices shall be factory sealed in order to prevent access to the inside of the unit. Side mount surge protection devices shall have factory-installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.3 SYSTEM APPLICATION

A. The surge protection device applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All surge protection devices shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards, Elevated Platforms)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

C. Surge Protection Device Type: All surge protection devices installed on the line side of the service entrance disconnect shall be Type 1 surge protection devices. All surge protection devices installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 surge protection devices.

2.4 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The surge protection device application covered under this section includes lighting and distribution panelboards. The surge protection device units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The surge protection device shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
2. Surge protection devices shall be installed immediately following the load side of the main breaker. Surge protection devices installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
3. The panelboard shall be capable of re-energizing upon removal of the surge protection device.
4. The surge protection device shall be interfaced to the panelboard via a direct bus bar connection. Alternately, a surge protection device connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the surge protection device. The surge protection device shall be located directly adjacent to the 30A circuit breaker.
5. The surge protection device shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The surge protection device shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the surge protection device shall be UL67 listed.

B. Sidemount Mounting Applications Installation (surge protection device mounted external to electrical assembly. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear, Switchboard, MCC, and Busway Requirements:

1. The surge protection device application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located surge protection devices shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The surge protection device shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway.
3. The surge protection device shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer
4. Locate the surge protection device on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The surge protection device shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the surge protection device. Connection shall be made via bus, conductors, or other connections originating in the surge protection device and shall be kept as short as possible.
6. The surge protection device shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.5 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general-purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or stainless steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4 – Constructed of stainless steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)
3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (Sidemount units only)

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. The Manufacturer shall submit a written statement indicating that a factory technician has inspected the installation. The installing contractor shall submit a checkout memorandum to the manufacturer. The memorandum shall indicate the date the equipment is placed into service and the actual method of installation. Submit three copies to the specifying engineer.

B. The installation of surge protection devices within or on electrical distribution equipment shall in no way compromise or violate equipment listing, labeling, or warranty of the distribution equipment.

C. Surge protection device shall use a separate path to building ground; the equipment safety ground is not to be used as a transient voltage ground path.

D. The installing contractor shall install the parallel surge protection device with short and straight conductors as practically possible.

E. The contractor shall follow the Surge Protection Device Manufacturer’s recommended installation practice as found in the equipment installation instructions.

F. The installation shall adhere to all applicable codes.

G. Route fail alarm circuits to autodialer and to PLC.

H. The Contractor shall install all equipment per the Manufacturer's recommendations and the contract drawings.

3.2 INSTALLERS

A. Installers of low-voltage lightning arresters shall be knowledgeable, and if required, certified, in all applicable electrical practices,standards, codes and wiring techniques as they pertain to installing surge suppressors.

B. Installers shall follow all applicable safety standards.

C. Installers shall follow manufacturer's installation instructions.

D. Installer shall mount surge protection device devices to keep phase and ground conductor as short as possible and free of sharp bends in conductors. Phase conductors to be equal length. Installer shall make corrections to installation as directed by Engineer.

3.3 FACTORY TESTING

Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

END OF SECTION

Section 16402

UNDERGROUND DUCT BANKS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Underground electrical duct banks.

1.02 REFERENCES

A. National Fire Protection Association (NFPA): No. 70 - National Electrical Code (NEC) Appendix B.

1.03 SUBMITTALS

A. Catalog cut sheets of the ducts and spacers.

1.04 DELIVERY, STORAGE AND HANDLING

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.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Thomas and Betts.

B. Underground Devices Inc.

C. Walker Division, Butler Manufacturing Company.

2.02 MATERIALS AND EQUIPMENT

A. Conduit. Construct ducts using schedule 80 rigid PVC conduit. Refer to Section 16111 - Conduit, Fittings and Bodies.

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. Refer to Section 03100 Concrete Formwork.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify from Drawings and field survey that the location of ductbanks does not interfere with any existing or new underground facilities.

B. Verify that materials are on site in proper condition and that sufficient quantity is on hand for the work.

C. Verify that trenches are in the correct places and prepared with sufficient depth and width to accommodate the duct banks, reinforcing rod, and concrete.

D. Be prepared for inspection of the duct banks before reinforcing rod is installed.

E. 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.

F. Provide 24-hour notice to Owner's Representative and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks.

3.02 INSTALLATION

A. Use the size and types of conduit as indicated on the Drawings for the various duct banks required for the project.

B. Make duct bank installations and penetrations through foundation walls watertight.

C. Assemble duct banks using non-magnetic saddles, spacers and separators. Position separators to provide 2-inch minimum concrete separation between the outer surfaces of the conduits.

D. 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.

E. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to ensure filling of spaces between ducts.

F. Make bends with sweeps of radius not less than 6 times the smallest diameter of the raceway.

G. Make a transition from non-metallic to pvc-coated metallic rigid conduit where duct banks enter structures or turn upward for continuation above grade.

H. Make bends of 30 degrees or more using rigid galvanized steel.

I. 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 2 inches from bars to the edge of the concrete encasement.

J. Where ducts enter structures such as handholes, manholes, pullboxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits. Tag conduit entering pull boxes with stamped, stainless steel tags. Identify as designated in cable and conduit schedule.

K. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials which can damage or contribute to corrosion of ducts or prevent adequate compaction of fill.

L. Install a bare stranded copper duct bank ground in each duct bank envelope. 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.

M. 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. Repull the rag or sponge swab until the swab emerges clean.

N. Use hemp rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose.

O. Install a warning ribbon approximately 12 inches below finished grade over underground duct banks. Refer to Section 16195 - Electrical Identification.

P. For manholes and pull boxes below grade, install wire racks to support cables properly around the perimeter and keep them dry.

Q. For manholes and pull boxes below grade, construct a French drain, or other drainage.

END OF SECTION

Section 16410

LOW VOLTAGE POWER FACTOR CORRECTION CAPACITORS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for low voltage power factor correction capacitors.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. NEMA CP-1: Shunt Capacitors

2. NEMA ICS-2: Industrial Control Devices, Controllers and Assemblies

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA): NFPA No. 70 - National Electrical Code (NEC) Article 460 - Capacitors.

C. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE): Standard No. 18 - Standard for Shunt Power Capacitors.

D. Underwriters Laboratories, Inc. (UL): UL 810 - Capacitors.

E. Power factor correction system shall comply with Houston Lighting and Power (H&LP) standard for harmonic distortion.

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01300 – Submittal Procedures:

1. Mounting dimensions and instructions

2. Equipment weights

3. Catalog data

4. Electrical schematics and wiring diagrams for control devices

5. Operating instructions for controls

1.04 QUALITY ASSURANCE

A. Tests

1. Perform tests in accordance with ANSI/NEMA CP-1. Each capacitor shall be subjected to manufacturing testing as described in ANSI/UL 810. Have test or inspections performed and evaluated by qualified personnel. Document deficiencies observed during the testing process and correct them prior to shipment.

2. Tests required include: short-time over voltage test, capacitance test, leak test and dissipation factor test.

3. Run a functional test on factory assembled automatic units.

1.05 DELIVERY, STORAGE AND HANDLING

A. Have capacitors packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. ABB Power T&D Company, Inc.

B. ASC Industries

C. Commonwealth Sprague Capacitor, Inc.

D. General Electric Company

E. Square D Company

2.02 MATERIALS AND EQUIPMENT

A. Capacitor Requirements

1. The capacitors shall provide power factor correction for individual motors 15 horsepower and above in the system by connecting each capacitor to the load side of the respective motor starter, or automatically switching capacitor banks on and off in accordance with the need for reactive power. See Drawings and one-line diagrams for details.

2. Use capacitors meeting the requirements stipulated in NEMA CP-1 and IEEE Standard No. 18.

3. The capacitor total losses shall not exceed 0.5 W per kVAR.

4. Select capacitors with permanently connected discharge resistors in full compliance with NEC Article 460-6(a) and (b).

5. Use capacitors which are the fused, fixed-type with multiple cells with dry-type dielectric enclosed in a stainless steel unpainted enclosure.

6. When individual motor circuits are equipped with power factor correction capacitors, connect the capacitors to the circuit between the contactor and the overload relay so as not to affect the true value of the motor current going through the overload relay heater coils.

7. Provide necessary mounting brackets and hardware of stainless steel with the capacitors.

8. Mount capacitors and control system in an enclosure suitable for the environment and as specified in Section 16160 - Cabinets and Enclosures.

    a. Provide a NEMA 4X, Type 316 enclosure.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Factory Assembled Unit. Verify dimensions of the housekeeping pad and the embedded leveling channels and conduit stub-ups if applicable.

B. Individual Capacitor for Each Motor. Verify dimensions of the capacitor mounting rack to ensure proper fit and accessibility for wiring and maintenance.

C. Controls in Control Panels - Capacitors separately mounted. Verify content of Motor Control Center section to ensure correct power and control devices and wiring.

3.02 INSTALLATION

A. Install equipment and wire up in accordance with the manufacturer's published instructions.

B. Torque bus bar bolts and cable connections to manufacturer's recommendations and tighten nuts and bolts on steel enclosures to ensure structural integrity.

C. Locate capacitors to allow adequate ventilation around the enclosures.

END OF SECTION

SECTION 16452

GROUNDING

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. Solid grounding of electrical systems and equipment.

B. Basic requirements for grounding for protection of life, equipment, circuits, and systems.

C. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

D. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.2 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.

1.3 SUBMITTALS

A. Provide submittals in accordance with Section 01300, Submittals.

B. Submit all products covered under this specification for Engineer's approval.

C. Test Results: Report of field tests and observations certified by Contractor.

D. 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.

1.4 QUALITY ASSURANCE

A. Items provided under this section shall be listed OR labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 - P R O D U C T S

2.1 GROUNDING AND BONDING PRODUCTS

A. 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.

B. Conductor Materials: Copper.

2.2 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.

2.3 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.

2.4 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.

2.5 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 - E X E C U T I O N

3.1 APPLICATION

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. Install separate insulated equipment grounding conductors with circuit conductors. Provide sufficient earth grounding provisions for all variable frequency drives.

1. 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.
2. 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 indicated.

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 250-30.

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 paragraph entitled Installation of this specification 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.

3.2 INSTALLATION

A. General: Ground electrical systems and equipment in accordance with current NEC requirements except where Drawings or Specifications exceed NEC requirements.

B. 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 bare-cable ground conductors to ground rods by means of exothermic welds.
4. Make connections without damaging copper coating or exposing steel.
5. Use 3/4-inch by 10-ft. ground rods except as otherwise indicated.
6. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.

C. Braided-Type Bonding Jumpers: Use elsewhere for flexible bonding and grounding connections.

D. 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.

E. Test Wells: Locate as indicated, and fabricate in accordance with details indicated.

F. 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 structures 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.

3.3 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: tin-plated 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 except those at test wells.

2. Install at connections to ground rods and plate electrodes.
3. Comply with manufacturer's written recommendations. Use CAD-Weld or approved substitution.
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 torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A-486B.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Compression-Type Connections: 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.

3.4 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.

3.5 FIELD 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 2-point 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.

3.6 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 topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

E. Restore disturbed paving as indicated.

END OF SECTION

Section 16461

DRY-TYPE TRANSFORMERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for dry-type transformers for the following applications:

1. Motor drive isolation

2. Shielded isolation

3. Non-linear loads

4. General purpose

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. ANSI No. C89.2: Transformers

2. NEMA ST 1: Specialty Transformers

3. NEMA ST-20: Dry-Type Transformers for General Applications

B. Underwriters Laboratories (UL): UL 506 - Standard for Safety Specialty Transformers.

C. American National Standards Institute/National Fire Protection Association ANSI/NFPA): NFPA No. 70 -National Electrical Code (NEC); Article 450 - Transformers and Transformer Vaults.

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Outline dimensions, support points and unit weight.

2. Electrical characteristics, including impedance and tap configuration.

3. Insulation type, rated temperature rise, and total insulation system.

4. Test reports, for transformers 300 KVA and above, indicating losses at 25, 50, 75 and 100 percent rated load and sound levels.

5. Connection diagrams.

6. Catalog data.

7. Operation and maintenance data.

1.04 QUALITY ASSURANCE

A. Tests. Run manufacturer's test on transformers in accordance with Underwriters Laboratories (U.L.) Standard No. UL-506.

1.05 DELIVERY, STORAGE AND HANDLING

A. Have transformers individually packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. ACME Transformer

B. Cutler-Hammer

C. General Electric

D. Hevi-Duty

E. Westinghouse Electric

F. Square D Company

2.02 MATERIALS AND EQUIPMENT

A. Use dry-type transformers for lighting system or other general purpose applications, motor drive isolation, shielded isolation and non-linear load requirements.

B. Provide transformers with copper windings.

C. Select transformers designed and constructed in accordance with NEMA ST-1, NEMA ST-20 and the NEC Article 450.

D. For applications up to 30 KVA, use transformers that are encapsulated, non-ventilated type with 115 degree C temperature rise and 185 degree C insulation class.

E. Provide transformers with full capacity winding taps a minimum of two 2-1/2 percent above and two 2-1/2 percent below normal voltage.

F. For applications of 30KVA and above use transformers that are the drip-proof ventilated type for indoor mounting only.

G. Use transformers with sound levels in accordance with NEMA ST-20.

H. Basic impulse level (BIL) shall be 10KV for transformers less than 300 KVA, 30KV for transformers 300KVA and larger.

I. Ground core and coil assembly to enclosure by means of a visible flexible copper strap.

J. Provide transformers with lifting eye bolts or brackets.

K. Provide transformer nameplates of stainless steel, marked in accordance with NEC Article 450-11. Fasten nameplate to the transformers with stainless steel screws or rivets.

L. Refer to the one-line diagram or the Drawings for transformer size, volt and wire configuration.

M. Special purpose transformers shall be as follows:

1. Motor drive isolation transformers: designed for 3-phase SCR controlled, variable speed motor voltages with bracing to withstand stresses associated with motor drives.

2. Shielded isolation transformers shall be designed for power inputs to microprocessors and computers that require additional protection from electrical disturbances with the use of grounded electrostatic shielding.

3. Non-linear transformers shall be designed to withstand the heating effects caused by harmonics resulting from non-linear, non-sinusoidal loads. Use K-rated transformers for non-linear loads.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify dimensions of housekeeping pads or other support structures to ensure proper fit.

B. Verify raceway and wiring drawings that are prepared for the transformers and check them against the manufacturer's information.

C. Verify that the protective devices planned for the transformers are in accordance with NEC Article 450.

3.02 INSTALLATION

A. Install transformers plumb and level and in accordance with manufacturer's instructions and the NEC Article 450.

B. Use flexible conduit for connection to transformer case. Make conduit connections to side panel of enclosure.

C. Mount transformers on isolation pads as required to isolate transformer noise from the buildings structure.

D. Wire transformer primary and secondary in accordance with the nameplate instructions and the designated voltages as shown on the one-line diagram.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

B. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.2 REFERENCES

A. Institute of Electrical and Electronic Engineers (IEEE):

1. IEEE C62.1 - Standard for Gap Silicon-Carbide Surge Arrestors for AC Power Circuits.
2. IEEE C62.11 - Standard for Metal-Oxide Surge Arrestors for AC Power Circuits.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA PB.1 - Panelboards.
2. NEMA PB1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 volts or less.

C. Underwriter's Laboratory (UL):

1. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors, 7th Edition.
2. 2. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings, 5th Edition.

1.3 DEFINITIONS

A. Load Center: Panelboard with thermal magnetic circuit-breaker branches, primarily of bolt-on type, designed for residential and light commercial projects, operating at 240 V and below, available in both single and 3-phase versions, and equipped with combination flush/surface mounting trim. Plug-in type breakers are not allowed.

B. Overcurrent Protective Device (OCPD): Device operative on excessive current that causes and maintains interruption of power in circuit it protects.

1.4 SUBMITTALS

A. Provide submittals in accordance with Section 01300, Submittals.

B. Submit all products covered under this specification for Engineer's approval.

C. Product Data:

1. For each type panelboard, accessory item, and component specified.
2. Identification materials.

D. Shop Drawings:

1. Dimensioned plans, sections, and elevations.
2. Tabulations of installed devices, major features, and voltage rating.
3. Include:
   a. Enclosure type with details for types other than NEMA Type 1.
   b. Bus configuration and current ratings.
   c. Short-circuit current rating of panelboard.
   d. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

E. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field- installed wiring.

F. Report of field tests and observations in accordance with this section.

G. Maintenance and Operations Data: Include instructions for testing circuit breakers.

H. 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.

1.5 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Terms "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Square D Company

B. General Electric

C. Or approved substitution.

2.2 PANELBOARDS, GENERAL REQUIREMENTS

A. Construction in accordance with NEMA PB1.

B. Overcurrent Protective Devices (OCPD’s):

1. Provide type, rating, and features as indicated.
2. Comply with Section 16475, Overcurrent Protective Devices, with OCPD’s adapted to panelboard installation.
3. Tandem circuit breakers shall not be used.
4. Multi-pole breakers shall have common trip.

C. Enclosures: Cabinets, enclosures, and panels, flush or surface mounted as indicated. NEMA Type 12 enclosure shall be use indoors, except where other enclosure requirements are indicated on drawings. Enclosures for all outdoor or wet locations, including indoor locations such as wastewater process areas and environmentally harsh locations, shall be NEMA 4X stainless steel, unless otherwise indicated on the drawings.

D. Front:

1. Secure to box with concealed trim clamps except as indicated.
2. Front for surface-mounted panels shall be same dimensions as box.
3. Fronts for flush panels shall overlap box except as otherwise specified.

E. Directory Frame: Metal, mounted inside each panel door.

F. Bus: Hard drawn copper of 98 percent conductivity.

G. Main and Neutral Lugs: Mechanical type.

H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

I. Service Equipment Approval: Listed for use as service equipment for panelboards having main service disconnect.

J. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

K. Special Features: Provide following features for panelboards as indicated.

1. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
2. Split Bus: Vertical bus of indicated panels divided into two vertical sections with connections as indicated.
3. Extra Gutter Space: Dimensions and arrangement as indicated.
4. Auxiliary Gutter: Conform to UL 870.
5. Column-Type Panelboard Configuration: Narrow cabinet extended as wireway to overhead junction box equipped with ground and neutral terminal buses.
6. Sub-feed: OCPD or lug provision as indicated.
7. Feed-Through Lugs: Sized to accommodate feeders indicated.
8. Surge Arresters: For panelboards as indicated on Plans.
   a. Comply with IEEE C62.11 or IEEE C62.1.
   b. Description: Coordinate impulse sparkover voltage with system circuit voltage and provide factory mounting with UL-recognized mounting device.

2.3 DISTRIBUTION PANELBOARDS

A. Branch-Circuit Breakers: Where OCPD's are indicated to be circuit breakers, use bolt-on breakers except circuit breakers 225-ampere frame size and greater may be plug-in type where individual positive locking device requires mechanical release for removal.

B. Doors:

1. In panel front, omit single panelboard door in cabinet front for fusible switch panelboards except as indicated.
2. Secure with vault-type with tumbler lock, all keyed alike.

2.4 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.

C. Spare Fuse Cabinet: Identified, compartmented, lockable stainless steel box or cabinet with compartments suitable for surface mounting on wall.

2.5 IDENTIFICATION

A. General: Provide nameplates for all panelboards.

B. Panelboard Nameplates: Engraved laminated plastic for each panelboard.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, and manufacturers' written installation instructions, and approved submittals.

B. Mounting Heights: Top of trim 6 ft 2-in. above finished floor, except as indicated.

C. Mounting:

1. Plumb and rigid without distortion of box.
2. Mount flush panels uniformly flush with wall finish.

D. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.

E. Install filler plates in unused spaces.

F. Provision for Future Circuits at Flush Panelboards:

1. Stub four 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future.
2. Stub four 1-inch empty conduits into raised floor space or below slab other than slabs on grade.

G. Auxiliary Gutter: Install where a panel is tapped to a riser at an intermediate location.

H. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

3.2 IDENTIFICATION

Identify field-installed wiring and components and provide warning signs in accordance with Section 16195, Electrical Identification.

3.3 GROUNDING

A. Connections: Make equipment grounding connections for panelboards as indicated.

B. Provide ground continuity to main electrical ground bus indicated.

C. Ground in accordance with Section 16452, Grounding.

3.4 CONNECTIONS

Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque- tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.5 FIELD QUALITY CONTROL

A. Perform tests on low-voltage power panelboards and accessories.

B. Upon completing installation of system, perform following tests:

1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.
2. Make continuity tests of circuits.

C. Quality Control Program.

1. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.
2. Notify Engineer at least one week in advance of testing.
3. Report Testing:
    a. Report written reports of tests and observations.
    b. Report defective materials and workmanship and unsatisfactory test results.
    c. Include records of repairs and adjustments made.
4. Protective Device Ratings and Settings:
    a. Verify indicated ratings and settings to be appropriate for final system configuration and parameters.
    b. Where discrepancies are found, recommend final protective device ratings and settings.
    c. Use accepted ratings or settings to make final system adjustments.

D. Visual and Mechanical Inspection: Include following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

5. Perform visual and mechanical inspection and related work for overcurrent protective devices as within this section.

E. Electrical tests: Include following items performed in accordance with manufacturer's instruction:

1. Insulation resistance test of buses and portions of control wiring that disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.
2. Ground resistance test on system and equipment ground connections.
3. Test main and sub-feed overcurrent protective devices in accordance within this section.

F. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards. Verify by system tests that total assembly meets specified requirements.

3.6 CLEANING

A. Upon completion of installation, inspect interior and exterior of panelboards.

B. Remove paint splatters and other spots, dirt, and debris.

C. Touch up scratches and mars of finish to match original finish.

D. Clean interior of panelboard.

3.7 ADJUSTING

Adjust doors and operating mechanisms for free mechanical movement.

3.8 COMMISSIONING

A. Balancing Loads: After Substantial Completion, but before Final Acceptance, conduct load-balancing measurements and circuit changes as follows:

1. Perform measurements during period of normal working load as advised by Owner.
2. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hr services such as Fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. Recheck loads after circuit changes during normal load period. Record load readings before and after changes and submit test records.
4. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Re-balance and recheck as required to meet this minimum requirement.

END OF SECTION

SECTION 16475

OVERCURRENT PROTECTIVE DEVICES

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of overcurrent protective devices (OCPD's) rated 600V and below and switching devices commonly used with them.

B. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.2 REFERENCES

A. National Electrical Manufacturers Association (NEMA).

1. NEMA KS-1 - Enclosed Switches.
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
3. NEMA FU1 - Low Voltage Cartridge Fuses.
4. NEMA AB1 - Molded Case Circuit Breakers and Molded Case Switches.

B. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code (NEC).

C. Underwriters Laboratory (UL):

1. UL 98 - Enclosed and Dead Front Switches.
2. UL 198C - High-Interrupting Capacity Fuses, Current-Limiting Types. Fifth Edition.
3. UL 198E - Class R Fuses. Fourth Edition.
4. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors. Seventh Edition.
5. UL 489 - Molded-Case Circuit Breakers and Circuit-Breaker Enclosures. Seventh Edition.
6. UL 943 - Ground-Fault Circuit Interrupters. Second Edition.
7. UL 977 - Fused Power-Circuit Devices. Third Edition.
8. UL 198L - UL Standard for Safety D-C Fuses for Industrial Use.

1.3 DEFINITIONS

A. Overcurrent Protective Device (OCPD): Device operative on excessive current that causes and maintains interruption of power in circuit it protects.

B. Ampere-Squared-Seconds: Expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, ampere-squared-seconds during fault current interruption represents energy allowed to flow before fuse or breaker interrupts fault current within its current limiting range.

1.4 SUBMITTALS

A. Provide submittals in accordance with Section 01300, Submittals.

B. Submit all products covered under this specification for Engineer's approval.

C. Shop Drawings: Spare fuse cabinet showing dimensions and features including storage provision for fused cartons, where shown on plans.

D. Product Data:

1. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time-current curves for protective devices and let-through current curves for those with current limiting characteristics.
2. Include coordination charts and tables and related data.

E. Test Results: Certified reports of field tests and observations.

F. 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.

G. Coordination: Contractor shall determine size, horsepower, voltage and phase of all equipment and motors supplied and shall adjust breaker and fused switch size accordingly and shall note on submittals. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.5 QUALITY ASSURANCE

A. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. Components and Installation:
   a. NFPA 70 "National Electrical Code (NEC)."
   b. Local codes and ordinances.

C. Single-Source Responsibility: Obtain similar OCPD’s from single manufacturer.

D. Coordinate OCPD sizes with characteristics of motors supplied for this project. Pay special attention to high efficiency motors.

E. 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.

1.6 MAINTENANCE

A. Extra Materials:

1. Maintenance Stock, Fuses: For types, voltage, and ampere ratings required furnish 10% spare fuses, but not less than one (1) set of three (3) of each kind.

PART 2 - P R O D U C T S

2.1 OVERCURRENT PROTECTIVE DEVICES (OCPD'S), GENERAL

A. General: Provide OCPD's in indicated types, as integral components of panelboards, switchboards, and motor control centers; and as individually enclosed and mounted single units.

B. Enclosures: NEMA 250, except that all outdoor areas and indoor environmentally harsh locations such as wastewater process areas shall be NEMA 4X stainless steel, unless otherwise noted on the drawings.

2.2 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers:

1. Square D Company
2. Or approved substitution

B. UL 489 and NEMA AB 1.

C. Construction: Bolt-in type, except breakers in load-center-type panelboards and breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

D. Characteristics: Indicated frame size, trip rating, number of poles, and short-circuit interrupting capacity rating of 10,000 amperes symmetrical, unless greater rating is indicated on Drawings.

E. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole. All service or feeder breakers to have removable trip plug, to have adjustable overcurrent trip, or to be electronic adjustable type.

F. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values.

G. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.

H. Enclosure for Switchboard or Motor Control Center Mounting: Provide individual mounting where indicated.

I. Enclosure for Independent Mounting: NEMA 4X stainless steel outdoor or damp environments, NEMA 1 stainless steel indoor enclosures, as required to suit environment where located, unless otherwise indicated on the drawings. 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.

J. Combination Circuit Breakers and Ground-Fault Circuit Interrupters: UL 943 arranged for sensing and tripping for ground-fault current in addition to overcurrent and short-circuit current.

1. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.
2. Trip Setting for Ground Fault: 4 to 6 milliamperes, listed and labeled as Class A, Type 1 device.
3. Trip Setting for Ground Fault: 30 milliamperes.

K. Current-Limiting Circuit Breakers: Arranged to limit let-through ampere-squared-seconds during fault conditions to value less than ampere-squared-seconds of one-half-cycle wave of prospective symmetrical fault current. Circuit breaker shall use no fusible devices in its operation. Current-limiting characteristic shall be in addition to normal time-delay and instantaneous-trip characteristics and other features as indicated.

L. Circuit Breakers With Solid-State Trip Devices: Provide indicated circuit breakers with solid-state trip devices having following features:

1. Ambient Compensation: Trip device insensitive to temperature changes between minus 20°C and plus 55°C.
2. Adjustability: Breaker ratings and trip settings shall be changeable by operation of controls on front panel of breaker, by change of plug-in element without removing breaker from mounting, or by combination of two methods.
3. Ground-Fault Tripping: Adjustable for pick-up and time-delay values. Provide for indicated units.
4. Provide clear plastic shield limiting access to rating plug and adjustments on solid-state trip circuit breaker. Seal by attaching sealing wire through hole in posts provided. With wire seal installed, circuit breaker rating plug and adjustments shall not be "readily accessible."

M. For all electronic breakers requiring programming unit for trip adjustments provide one (1) unit for Owner and Engineers use in setting adjustments after contract ends. This unit to be supplied in new box with all appurtenances included. Submit unit to Engineer for examination prior to final acceptance testing of equipment.

2.3 INSULATED-CASE CIRCUIT BREAKERS

A. Manufacturers:

1. Square D Company
2. Or approved substitution

B. UL 489 and NEMA AB 1.

C. Ratings: Continuous-current, interrupting, and short-time-current ratings, and voltage and frequency ratings as indicated.

D. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with following features:

1. Moving Contacts Closing Speed: Independent of both control and operator.

E. Circuit-Breaker Trip Devices: Solid-state overcurrent trip device system that includes one (1) integrally mounted current transformer or sensor per phase, release mechanism, and following features:

1. Functions: Long-time-delay, short time delay, and instantaneous-trip functions, which are independent of each other in both action and adjustment.
2. Temperature compensation to assure accuracy and calibration stability from minus 20°C to plus 55°C.
3. Field-adjustable, time-current characteristics.
4. Current Adjustability: Effected by operating controls on front panel or by changing plug-in elements or current transformers or sensors.
5. Three bands for long-time- and short-time-delay functions marked "minimum," "intermediate," and "maximum."
6. Five (5) pickup points, minimum, for long-time- and short-time-trip functions.

7. Six (6) pickup points, minimum, for instantaneous-trip functions.
8. Ground fault protection with at least three (3) short-time-delay settings and thirty-seven (37) trip- time-delay bands. Adjustable current pickup.
9. Trip Indication: Labeled lights or mechanical indicators on trip device shall indicate type of fault causing breaker trip. If lights are used, integral power source shall maintain indication for 60 hours, minimum.

F. Auxiliary Contacts for Remote Indication: Where remote indication of breaker position is indicated, provide spare auxiliary switch in addition to other auxiliary switches required for normal breaker operation. Spare

auxiliary switch shall consist of two (2) Type “a” and two (2) Type “b” stages (contacts), wired to terminal block in breaker housing.

G. Circuit-Breaker Features and Accessories: Includes the following:

1. Padlocking Provisions: For installing at least two (2) padlocks on each breaker to secure its enclosure and prevent movement of draw out mechanism.
2. Operating Handle: Provide one (1) for each manually operated breaker. No handle ties are permitted.
3. Electric Close Button: Provide one (1) for each electrically operated breaker.
4. Indicating Lights: Contacts for "Breaker Open" and "Breaker Closed," for main and bus tie circuit breakers, and for other indicated breakers.

2.4 OCPD ACCESSORIES

A. Key Interlocks: Arrange interlocking so keys are held captive at devices indicated. Where future key interlocking provisions are indicated, provide necessary mountings and hardware as required for future installation.

B. Instantaneous Undervoltage Trip Device: For indicated OCPD’s.

C. Adjustable-Time-Delay Undervoltage Trip Devices: For indicated OCPD’s.

D. Shunt-Trip Devices for Circuit Breakers: Where indicated, arrange to trip breaker from external source of power through control switch or relay contacts.

E. For all electronic breakers requiring programming unit for trip adjustments provide one (1) unit for Owner and Engineers use in setting adjustments after contract ends. This unit to be supplied in new box with all appurtenances included. Submit unit to Engineer for examination prior to final acceptance testing of equipment.

F. All service and feeder breakers to have removable trip plug, to have adjustable overcurrent trip, or to be electronic adjustable type.

2.5 ENCLOSURES

Where OCPD’s are installed in enclosures. Provide for operating via external lockable three (3) point latching handle without removing a cover or a bolted-on plate. Lockable hinged door access is acceptable where approved by Engineer or where required by enclosure classification. All outdoor enclosures to be NEMA 4X stainless steel unless specifically show otherwise on plans or approved by Engineer in writing.

2.6 MOTOR CIRCUIT PROTECTION (MCP)

Provide electronic type MCP for motor starters. Unit shall learn inrush current and adjust accordingly.

2.7 LOAD SIZE CONNECTIONS

Where OCPD serves as an incoming service main breaker or switch, include provisions for fixture connection of transfer switch conductor lugs. Provide removable bus bars. Provide adequate wiring space inside enclosure.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Independently Mounted OCPD's: Locate as indicated and install in accordance with manufacturer's written installation instructions.

B. Factory install OCPD's furnished in distribution equipment.

C. Coordinate size overcurrent protective devices with each motor and equipment manufacturer to assure correct size devices and provide accordingly.

3.2 IDENTIFICATION

Identify with components as specified in Section 16195, Electrical Identification.

3.3 CONTROL WIRING INSTALLATION

Install wiring between OCPD's and control/indication devices as specified in Section 16120, 600 Volt Building Wire and Cable, for hard-wired connections.

3.4 CONNECTIONS

A. Check connectors, terminals, bus joints, and mountings for tightness.

B. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.5 GROUNDING

A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

B. Ground in accordance with Section 16452, Grounding.

3.6 COORDINATION STUDY

Provide coordination study to determine settings for overcurrent protective devices. Where coordination study recommends changes in types, classes, features or ratings of equipment or devices those indicated, make written request for instructions. Obtain instructions from Engineer before ordering equipment or devices recommended to be changed. Make all settings and adjustments according to coordination study results. Provide hard copy records of study for Engineer's review.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Manufacturer's Technician for equipment specified herein shall be present at job site for assistance during plant startup, equipment adjustment, and training of Owner's personnel for plant operation.
2. Factory Technician shall make all adjustments and settings.
3. Manufacturers Technician shall be for final acceptance and testing and shall demonstrate equipment operation to Engineer and Owner's Representative.

B. Testing:

1. Reports: Prepare certified written reports on tests and observations. Report defective materials, workmanship, and unsatisfactory test results. Include complete records of repairs and adjustments made.
2. Labeling: Upon satisfactory completion of tests and related effort, apply label to tested components indicating test results, date, and responsible person.
3. Schedule visual and mechanical inspections and electrical tests with at least one (1) week's advance notification.
4. Pre-testing: Upon completing installation of system, perform following preparations for tests:
   a. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
   b. Make continuity tests of circuits.
   c. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
   d. Comply with manufacturer's instructions for installation and testing of OCPD's.
5. Visual and mechanical inspection: Include following inspections and related work.
   a. Overcurrent Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make final system adjustments.
   b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
   c. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
   d. Check tightness of electrical connections of OCPD's with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
   e. Clean OCPD's using manufacturer's approved methods and materials.
   f. Verify installation of proper fuse types and ratings in fusible OCPD's.
6. Electrical Tests: Include following items performed in accordance with manufacturer's instructions:
   a. Insulation resistance test of OCPD conducting parts. Insulation resistance less than 100 megohms is not acceptable.
   b. Verify trip unit reset characteristics for insulated-case circuit breakers.
   c. Make adjustments for final settings of adjustable-trip devices.

d. Activate auxiliary protective devices such as ground fault or undervoltage relays, to verify operation of shunt-trip devices.

e. Check stored-energy charging motors for proper operation of motor, mechanism, and limit switches.

f. Check operation of electrically operated OCPD's in accordance with manufacturer's instructions.

g. Check key and other interlock and safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including moveable barriers and shutters.

7. Retest: Correct deficiencies identified by tests and observations and retest. Verify by system tests that specified requirements are met.

3.8 CLEANING

Upon completion of installation, inspect OCPD's. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION

SECTION 16476

JACKING, BORING, OR TUNNELING PIPE OR BOX

PART 1 DESCRIPTION

A. Furnish and install pipe or box by jacking, boring, or tunneling.

PART 2 MATERIALS

A. Use the following types of pipe or box:

1. corrugated metal pipe meeting Item 02611, "Steel Pipe and Fittings," of the size, type, design, and dimension shown on the plans;

2. reinforced concrete pipe meeting the special requirements for jacking, boring, or tunneling of Item 02615, "Reinforced Concrete Pipe," of the size, strength, and dimension shown on the plans;

3. reinforced concrete box meeting Item 02617, "Precast Reinforced Concrete Box Sewers," of the size and type shown on the plans; or

4. other types specified by the plans.

PART 3 CONSTRUCTION

A. Excavate suitable shafts or trenches for conducting the jacking, boring, or tunneling operations and for placing end joints of the pipe or box if the grade at the jacking, boring, or tunneling end is below the ground surface. Protect excavations deeper than 5 ft. as specified in Item 02227, "Excavation and Backfill for Utilities."

B. Install pipe or box so there is no interference with the operation of street, highway, railroad, or other facility and no embankment or structure is weakened or damaged.

C. Repair any pipe or box damaged in jacking, boring, or tunneling. Remove and replace any pipe or box damaged beyond repair at the Contractor's expense.

D. Immediately after installation of pipe or box, backfill shafts or trenches excavated to facilitate jacking, boring, or tunneling.

3.01 JACKING

A. Provide jacks suitable for forcing the pipe or box through the embankment. Use even pressure to all jacks during operation. Provide a suitable jacking head and suitable bracing between the jacks and the jacking head to apply uniform pressure around the ring of the pipe or circumference of the box. Use joint cushioning of plywood or other approved material. For plywood cushioning material, use 1/2 in. minimum thickness

for pipe diameter 30 in. or less, and use 3/4 in. minimum thickness for pipe diameter greater than 30 in. Use 3/4 in. minimum thickness for all boxes. Use cushioning rings of single or multiple pieces. Provide a suitable jacking frame or backstop. Set the pipe or box to be jacked on guides that support the section of the pipe or box, and direct it on the proper line and grade. Place the entire jacking assembly in line with the direction and grade of the pipe or box. In general, excavate the embankment material just ahead of the pipe or box, remove the material through the pipe or box, and force the pipe or box through the embankment with jacks into the space provided.

B. Furnish a plan showing the proposed method of jacking for approval. Include the design for the jacking head, jacking support or backstop, arrangement and position of jacks, and guides in the plan.

C. Ensure that excavation for the underside of the pipe for at least 1/3 of the circumference of the pipe conforms to the contour and grade of the pipe. Ensure that the excavation for the bottom slab of the box conforms to the grade of the box. If desired, over excavate to provide not more than 2 in. of clearance for the upper portion of the pipe or box. Taper this clearance to zero at the point where the excavation conforms to the contour of the pipe or box. Pressure-grout any over excavation of more than 1 in.

D. The distance that the excavation extends beyond the end of the pipe or box must not exceed 2 ft. Decrease this distance as necessary to maintain stability of the material being excavated.

E. Jack the pipe or box from the low or downstream end. The final position of the pipe or box must not vary from the line and grade shown on the plans by more than 1 in. in 10 ft. Variation must be regular and in 1 direction, and the final flow line must be in the direction shown on the plans.

F. If desired, use a cutting edge of steel plate around the head end of the pipe or box extending a short distance beyond the end.

3.02 BORING

A. Bore from a shaft in an approved location provided for the boring equipment and workmen.

B. Dispose of excavated material using a method approved by the Owner's Representative. Use water or other fluids in connection with the boring operation only as necessary to lubricate cuttings; do not use jetting.

C. In unconsolidated soil formations, use a gel-forming colloidal drilling fluid consisting of high-grade, carefully processed bentonite to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and immediate installation of the pipe.

D. Allowable variations from line and grade are specified in Section 16476, Part 3, 3.01 "Jacking." Pressure-grout any over excavation of more than 1 in.

E. Use a pilot hole or auger method for the boring.

1. Pilot Hole Method

a. Bore a 2 in. pilot hole the entire length of the crossing, and check it for line and grade on the opposite end of the bore from the work shaft. This pilot hole will serve as centerline for the larger diameter hole to be bored.

2. Auger Method

a. Use a steel encasement pipe of the appropriate diameter equipped with a cutter head to mechanically perform the excavation. Use augers of sufficient diameter to convey the excavated material to the work shaft.

3.03 TUNNELING

A. Use an approved tunneling method where the characteristics of the soil, the size of the proposed pipe, or the use of monolithic pipe would make the use of tunneling more satisfactory than jacking or boring or when shown on the plans.

B. When tunneling is permitted, ensure that the lining of the tunnel is of sufficient strength to support the overburden. Submit the proposed liner method for approval. Approval does not relieve the Contractor of the responsibility for the adequacy of the liner method.

C. Pressure-grout the space between the liner plate and the limits of excavation.

3.04 JOINTS

A. If corrugated metal pipe is used, make joints by field bolting or by connecting bands, whichever is feasible. If reinforced concrete pipe is used, make the joints in accordance with Item 02615, "Reinforced Concrete Pipe." If reinforced concrete box is used, make the joints in accordance with 02617, "Precast Reinforced Concrete Box Sewers."

PART 4 MEASUREMENT

A. This Item will be measured by the foot between the ends of the pipe or box along the flow line.

B. This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal. Additional measurements or calculations will be made if adjustments of quantities are required.

PART 5 PAYMENT

A. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Jacking, Boring, or Tunneling Pipe" of the type, size, and class specified; or "Jacking, Boring, or Tunneling Pipe" of the type, size, and design specified; or "Jacking or Tunneling Box Culvert" of the size specified.

B. This price is full compensation for excavation, grouting, backfilling, and disposal of surplus material; furnishing pipe, box, and pipe liner materials required for tunnel operations; preparation, hauling, and installing of pipe, box, and pipe liner materials; and materials, tools, equipment, labor, and incidentals.

C. Protection methods for open excavations deeper than 5 ft. will be measured and paid for as required under Item 02227, "Excavation and Backfill for Utilities."

END OF SECTION

SECTION 16476A

DISCONNECTS AND CIRCUIT BREAKERS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of the following:

1. Service disconnects.
2. Feeder and equipment disconnects.
3. Enclosed circuit breakers.

B. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.2 SUBMITTALS

A. Provide submittals in accordance with Section 01300, Submittals.

B. Submit all products covered under this specification for Engineer's approval.

C. 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.

D. Shop Drawings: Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

E. Test Results: Field test reports indicating and interpreting test results.

F. Operating and Maintenance Data: Maintenance data for tripping devices

G. 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.

H. Coordination: Contractor shall determine size, horsepower, voltage, and phase of all equipment and motors supplied and shall adjust breaker and fused switch size accordingly and shall note on submittals. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.3 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

C. Single-Source Responsibility: Enclosed switches and circuit breakers shall be product of single manufacturer.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Molded-Case Circuit Breakers:

1. Square D Company
2. Pre-approved substitution

B. Combination Circuit Breaker and Ground Fault Trip:

1. Square D Company
2. Pre-approved substitution

C. Molded-Case Current-Limiting Circuit Breakers:

1. Square D Company
2. Pre-approved substitution

2.2 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 beNEMA 4X 316 stainless steel, unless shown otherwise on drawings.

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.

2.3 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 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, unless shown otherwise on drawings.

2.4 ACCESSORIES

A. Provide new programming unit and all accessories for solid-state breakers requiring programming unit for settings adjustment.

B. Original set-up and adjustments shall be performed by the circuit breaker manufacturer's factory Representative.

2.5 TRIP UNITS

All service and feeder breakers to have replaceable trip plugs, or be adjustable (load current), or be electric type with adjustable trips.

PART 3 - E X E C U T I O N

3.1 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 torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Supplier's or manufacturer's representative for equipment specified herein shall be present at job site or for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation.

B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.5 for enclosed switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

C. Training:

1. Train Owner's maintenance personnel on procedures and schedules for startup and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Review operating and maintenance data.

3.3 ADJUSTING

Set field-adjustable enclosed switches and circuit breaker trip ranges as indicated.

3.4 CLEANING

After completing system installation including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

SECTION 16481

MOTOR CONTROLLERS

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of AC motor control devices rated 600 volts and below.

B. Overcurrent protective devices and disconnect switches used with motor controllers are specified in Section 16475, Overcurrent Protective Devices.

C. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.2 DEFINITIONS

A. Motor Controller: Device that controls, protects, and energizes electric motor, and where required, controls its speed or torque or power delivered by it.

1.3 SUBMITTALS

A. Provide submittals in accordance with Section 01300, Submittals.

B. Submit all products covered under this section for Engineer's approval.

1. Product Data: Include dimensions, ratings, and data on features and components.
2. Test Results: Certified reports of field tests and observations.
3. Miscellaneous: Load Current and Overload Relay Heater List: Compiled by Contractor after motors have been installed. Arrange list to demonstrate selection of heaters to suit actual motor nameplate full load currents.
4. Operation and Maintenance (O&M) Data: Manufacturer's data on maintenance and operation of equipment.

C. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies", "Non-Compliance", or "Exceptions" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain similar motor-control devices from single manufacturer.

B. Manufacturer Qualifications: Provide controllers from manufacturers regularly engaged in manufacture of equipment of types and capacities indicated, with such products in satisfactory use in similar service for not less than 5 yrs.

C. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

D. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) No. 70.

E. Testing and Startup: All elements of each electrical control system shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification. All special testing of materials and equipment shall be provided by the Contractor. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner and Systems Integration Engineer. As a minimum, the testing shall include both a factory test and a field test. Testing requirements are as follows:

1. 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.
2. 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 paragraph-by-paragraph 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 two (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 ten (10) days without failure. Any failures shall be repaired and test shall start over again.
3. Pump Controller Program: Where applicable, testing will require a minimum of ten (10) working days after programs are downloaded to the pump controller. This shall be accounted for in project schedule.
4. Where applicable, prior to testing system, PLC programs or HMI programs shall be furnished on CD for review by Engineer.

1.5 COORDINATION

A. Coordinate features of controllers and control devices with pilot devices and control circuits provided under other sections of Specifications covering control systems.

B. Coordinate motor controls, starters and overcurrent devices with motor manufacturer’s data. Provide motor manufacturer’s data sheets to motor control manufacturer at time of order.

1.6 MAINTENANCE

A. Extra Materials:

1. Spare Fuses and LED Lamps: Furnish one spare for every five (5) installed units, but not less than one set of three (3) of each kind.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Manual and Magnetic Motor Controllers:

1. Square D Company.
2. Or, pre-approved substitution.

2.2 MOTOR CONTROLLERS, GENERAL

A. Coordinate features of each motor controller with ratings and characteristics of supply circuit, motor, required control sequence, duty cycle of motor, drive, and load, and pilot device, and control circuit affecting controller functions. Provide controllers horsepower rated to suit motor controlled.

B. NEMA Size 1 minimum.

C. Contacts shall open each ungrounded connection to motor.

D. Overload Relays:

1. Ambient-compensated type with inverse-time-current characteristic.
2. Provide with heaters or sensors in each phase matched to nameplate full load current of specific motor to which connected with appropriate adjustment for duty cycle. Overload devices to require manual reset after tripping occurs.
3. Enhanced Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics for submersible equipment or where indicated. Select to protect motor against voltage unbalance and single phasing.

E. Enclosures:

1. For individually mounted motor controllers and control devices, comply with NEMA 250.
2. Provide enclosures suitable for environmental conditions at controller location.
3. Provide NEMA Type enclosures as indicated or required to suit environment where located.
4. All enclosures for motor starters 100 hp and greater shall have forced cooling.
5. All enclosures to have 120-volt space heaters.
6. Provide door restraints for all inner and outer doors.

F. Control Diagrams: Provide complete and accurate control diagrams and one-line diagram laminated in clear plastic and installed in door pockets of motor control center.

2.3 MANUAL MOTOR CONTROLLERS

A. Quick-make, quick-break toggle action.

B. Double-break silver alloy contacts.

C. Pilot light.

D. Padlocking provision.

2.4 MAGNETIC MOTOR CONTROLLERS

A. Full voltage, non-reversing, across-the-line, magnetic controller, except where another type indicated.

B. Control Circuit: 120 volts. Control power transformer integral with controller where no other supply of 120-volt control power to controller indicated. Control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100% spare capacity.

C. Combination Controller: Switch type; fused or non-fused as indicated; quick-make, quick-break switch; factory assembled with controller and arranged to disconnect it. For fused switches, provide rejection type fuseclips and fuses rated as indicated.

D. Combination Controller: Motor circuit protector; molded case circuit breaker type with magnetic only trip element calibrated to coordinate with actual locked rotor current of connected motor and controller overload relays. Provide breakers factory-assembled with controller, interlocked with unit cover or door, and arranged to disconnect controller. Provide motor circuit protectors with field-adjustable trip elements.

E. Overvoltage/Undervoltage/Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

1. Provide in starter enclosure for Size 2 and larger starters.
2. Delay initial motor start.
3. Delay motor restart due to starter dropout caused by undervoltage or starter coil circuit interruption for maintained control circuits.
4. Adjustable on delay from 0.15 to 30.0 sec set at 10.0 sec.
5. Connect control relay in motor starter coil circuit.
6. Coordinate control relay selection with motor starter to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starterto ensure if motor starter drops out, relay will drop out.

F. For combination starter units provide interlocks so disconnect means must be in “Off” position beforedoor can be opened and so door cannot be closed with disconnect means in “On” position, except by consciously operating permissive release devices. Rotating type operators located outside of door are not acceptable.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. General: Install motor controllers and auxiliary motor control devices in accordance with manufacturer's written instructions and approved submittals.

B. Mounting:

1. For control equipment at walls, bolt single units to wall. Mount multiple units on light-weight structural steel channels bolted to wall.
2. For controllers not at walls, provide freestanding racks fabricated of structural steel members and light-weight slotted structural steel channels. Use feet consisting of 3/8 in. thick steel plates, 6 in. square, bolted to floor. Use feet for welded attachment of 1-1/2-in. by 1-1/2-in. by 1/4 in. vertical angle posts not over 3 ft oc. Connect posts with horizontal lightweight slotted steel channels and bolt control equipment to channels.
3. Unless shown otherwise on plans.

C. Motor Controller Fuses and Circuit Breakers: Conform to requirements of Section 16475 – "Overcurrent Protective Devices."

D. Cabinet and Enclosures Heights: Cabinet, panel and enclosure heights shall not exceed 6 feet – 6 inches from floor to top fastening devices to allow access by Operator without use of ladders or steps to open enclosure doors.

3.2 IDENTIFICATION

Comply with Section 16195, Electrical Identification.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring as specified in Section 16120, 600-Volt Building Wire and Cable.

B. Install wiring in enclosures bundled, trained, and supported.

3.4 CONNECTIONS

Tighten connectors, terminals, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements not indicated, comply with tightening torques specified in UL 486A and 486B.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by Owner for minimum man-days indicated, travel time excluded, for equipment adjustment, and training of Owner's personnel for plant operation. Include minimum of two man-days for Instructional Services.

B. Testing:

1. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.
2. On completing installation of system, perform following tests.
    a. Make insulation resistance tests of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by manufacturer.
    b. Make continuity tests of circuits.
    c. Review updating of final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
    d. Review manufacturer's written instructions for installation and testing of motor control devices.
3. Visual and Mechanical Inspection: Include following inspections and related work.
    a. Motor Control Device Ratings and Settings: Verify ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective device ratings and settings where differences found. Use accepted revised ratings or settings to make final system adjustments.
    b. Inspect for defects and physical damage and nameplate compliance with Drawings.
    c. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's written instructions.

d. Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturer's recommended torque values.

e. Clean devices using manufacturer's approved methods and materials.

f. Verify proper fuse types and ratings in fusible devices.

4. Electrical Tests: Perform following in accordance with manufacturer's written instructions.

a. Insulation resistance test of motor control devices conducting parts to extent permitted by manufacturer's written instructions. Insulation resistance less than 100 megohms not acceptable.

b. Use primary current injection to check performance characteristics of motor circuit protectors and for overload relays of controllers for motors 15 hp and larger. Trip characteristics not within manufacturer's published time-current tolerances not acceptable.

c. Make adjustments for final settings of adjustable trip devices.

d. Test auxiliary protective features such as loss of phase, phase unbalance, and undervoltage to verify operation.

e. Check for improper voltages at terminals in controllers having external control wiring when controller disconnect opened. Voltage over 30 v unacceptable.

5. Correct deficiencies and retest motor control devices. Verify by system tests that specified requirements are met.

3.6 ADJUSTING

A. Overvoltage/Undervoltage/Phase Failure Control Relay: Adjust control relay to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out.

3.7 CLEANING

Remove paint splatters and other spots, dirt, and debris. Touch-up scratches and mars of finish to match original finish. Clean devices internally using manufacturer's recommended methods and materials.

END OF SECTION

SECTION 16494

MANUAL TRANSFER SWITCH

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of a manual transfer switch.

B. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

C. Under no conditions shall transfer switch ampacity be rated less than main service breaker ampacity.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. C37.90.1 - Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.

B. National Electrical Manufacturers Association (NEMA):

1. ICS 1 - General Standards for Industrial Control and Systems.

C. National Fire Protection Association (NFPA):

1. NFPA No. 70 - National Electrical Code (NEC).
2. NFPA No. 110 - Standard for Emergency and Standby Power Systems.

D. Underwriters Laboratories, Inc. (UL):

1. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
2. 508 - Industrial Control Equipment.
3. 1008 - Automatic Transfer Switches.

1.3 SUBMITTALS

A. Provide submittals in accordance with Section 01300, Submittals.

B. Submit all products covered under this specification for Engineer's approval.

C. Product Data:

1. Submit for each transfer switch, including dimensioned plans, sections, and elevations showing minimum clearances; conductor entry provisions; gutter space; installed features and devices; and materials lists.
2. Wiring diagrams, elementary or schematic, differentiating between manufacturer-installed and field-installed wiring.

3. Single-line diagrams of transfer switch units showing connections between transfer switch, emergency source, normal source, and load, plus interlocking provisions.

D. Test Results: Certified reports of field tests and observations.

E. Miscellaneous: Manufacturer's certificate of compliance to referenced standards and tested short-circuit closing and withstand ratings applicable to protective devices and current ratings used in this Project, as indicated and as specified in this section.

F. Operation and Maintenance (O&M) Data:

1. Include features and operating sequences, automatic and manual.
2. Submit to Engineer for approval.

G. 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.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated and having record of successful in-service performance.

B. Emergency Service: Manufacturer maintains service center capable of providing emergency maintenance and repairs at Project site with 8-hr maximum response time.

C. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

D. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA No. 70.

E. Single Source Responsibility: Obtain and remote annunciator and control panels from single manufacturer that assumes responsibility for system components furnished.

F. Where manual transfer switch is a product of Manufacturer’s listed below and meets ampacity and fault current ratings required, non-U.L. listed switch may be furnished upon acceptance by Engineer.

G. Where switch will be opened under load, select Manufacturer below who manufactures a service rated switch.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Square D

B. Siemens

C. Or pre-approved substitution, in writing.

2.2 TRANSFER SWITCH PRODUCTS, GENERAL

A. Number of Poles and Current and Voltage Ratings:

1. Knife type switch with external operating handle located on side of enclosure.
2. Manufactured, off-the-shelf switch. Not one-of-a-kind construction.
3. Ampacity oftransfer switch contacts shall be rated equal or greater than ampacity of main service breaker. No exceptions.

B. Neutral Terminal: Where 2- or 3-pole switches are indicated, provide fully rated, solid, un-switched neutral terminal except as indicated.

C. Enclosures: General purpose, NEMA 1, conforming to UL 508, except as otherwise indicated for indoor use. NEMA 4X stainless steel for outdoor use or, NEMA 3R where specifically shown for locations exposed to water.

D. Factory Wiring: Train and bundle factory wiring and identify consistently with Shop Drawings, by color code or by numbered or lettered wire and cable tape markers at terminations.

1. Designated terminals accommodate field wiring.
2. Power Terminals Arrangement and Field Wiring Space: Suitable for top, side or bottom entrance of feeder conductors as indicated.
3. Terminals: Pressure type, suitable for copper or aluminum conductors of sizes indicated.
4. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

E. Switch Action: Mechanically held in both directions for double-throw switches.

F. Switch Contacts: Use silver composition for switching load current. Provide separate arcing contacts for units rated 225 amps and more.

G. Fused switches shall be provided only where noted on plans.

2.3 FINISHES

A. Enclosures: NEMA 1 and NEMA 3R Manufacturer's standard enamel over corrosion-resistant pretreatment and primer; NEMA 4X 316 stainless steel.

2.4 SOURCE QUALITY CONTROL

Factory test components, assembled switches, and associated equipment to ensure proper operation. Perform dielectric strength test conforming to NEMA ICS 1.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Floor Mounting of Transfer Switches:

1. Where concrete slab is indicated under transfer switch location, provide legs on switch and 4-in. high concrete foundation pad.
2. Level and anchor unit to equipment pad.

B. Rack mounted switch to be installed on stainless steel unistrut rack as shown on plans.

C. Identify components in accordance with Section 16195, Electrical Identification.

3.2 CONNECTIONS

A. Tighten factory-made connections and field connections, including connectors and terminals, screws and bolts, according to equipment manufacturer's published torque tightening values.

B. When manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

3.3 GROUNDING

A. Make equipment grounding connections for transfer switch units as indicated and as required by NEC.

B. Ground in accordance with Section 16452, Grounding.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Supplier or manufacturer shall direct services to specific system and equipment operation, maintenance, field tests, and troubleshooting.

B. Preliminary Tests: Perform electrical tests as recommended by manufacturer and as follows.

1. Measure phase-to-phase and phase-to-ground insulation resistance levels with insulation resistance tester. Use test voltages and procedure recommended by manufacturer. Meet manufacturer's specified minimum resistance.
2. Check for electrical continuity of circuits and for short circuits.

END OF SECTION

Section 16510

LIGHTING FIXTURES

PART 1 G E N E R A L

1.03 SECTION INCLUDES

A. Specification for:

1. High intensity discharge (HID) lighting fixtures

2. Photo cells

1.04 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

1. No. 70 - National Electrical Code (NEC)

a. Article 410 - Lighting Fixtures, Lampholders, Lamps and Receptacles

b. Article 500 - Hazardous (classified) locations

c. Article 700 - Emergency Systems

2. No. 101 - Life Safety Code

B. American National Standards Institute (ANSI)

1. C78.379 - Electric Lamps - Incandescent and High Intensity discharge Reflector Lamps - Classification of Beam Patterns.

2. C82.1 - Ballasts for Fluorescent Lamps - Specifications.

3. C82.4 - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

C. American National Standards Institute/Illuminating Engineering Society (ANSI/IES): The IES Handbook shall be used as a basis for design and construction of lighting systems.

D. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc./Illuminating Engineering Society (ASHRAE/IES): ASHRAE/IES 90.1 - 1989 - Energy Efficient Design of new Buildings Except Low-Rise Residential Buildings.

E. American National Standards Institute/Underwriters Laboratories (ANSI/UL).

1. UL1570 - Fluorescent Lighting Fixtures.

2. UL1571 - Incandescent Lighting Fixtures.

3. UL1572 - High Intensity Discharge Lighting Fixtures.

4. UL844 - Fixtures for Hazardous Areas.

1.05 SUBMITTALS

A. Submit the following under the provisions of Section 01300 – Submittal Procedures:

1. Outline dimensions, support points and unit weight.

2. Operation and maintenance data.

3. Complete test report with photometric curves.

4. Storage, handling, and installation recommendation.

5. Connection diagrams.

6. Catalog data.

1.06 QUALITY ASSURANCE

A. Tests. Run manufacturer's tests on lighting fixtures in accordance with applicable Underwriters Laboratories (U.L.) Standards 1570, 1571 and 1572.

1.07 DELIVERY, STORAGE AND HANDLING

A. Have lighting fixtures individually packed to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Benjamin Div., Thomas Industries

B. Crouse-Hinds, Div. of Cooper Industries

C. G.E. Lighting System

D. Guth Lighting

E. Holophane Company, Inc.

F. Hubbell Lighting, Inc.

G. Killark Electric Mfg. Company

H. Lithonia Lighting

I. Pauluhn Electric

J. Wide-Lite Corporation

K. Dual-Lite Company

2.02 REQUIREMENTS

A. Provide lighting fixtures in accordance with the lighting plan Drawings, Lighting Fixture Schedules and this specification. Such fixtures shall be shielded to assure that there is no direct horizontal distribution of lighting from the fixture.

B. High-Intensity Discharge (HID) Fixtures

1. Provide fixtures that are High Pressure Sodium (HPS) type.

2. Select fixtures which are enclosed and gasketed with mogul base porcelain lamp socket.

3. Use ballast high power factor type with taps for 120V, 208V and 277V input voltage, conforming to ANSI Standard C82.4.

4. Refer to Drawings or fixture schedules specific types, sizes and mounting hardware.

C. Photo Cells

1. Provide a photo cell to control outdoor fixtures unless otherwise indicated on the lighting plans.

2. 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.

3. 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.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Check the types and quantity of fixtures to be mounted in the area to be illuminated and verify that materials are on hand.

B. Pick out the correct bulbs for the fixtures along with the necessary accessories and mounting hardware.

3.02 INSTALLATION

A. Install fixtures in accordance with manufacturer's instructions, NEC Articles 410, 500 and 700 as applicable, and the Drawings.

B. Wire up fixtures in accordance with the Drawings and ensure proper switching, circuiting and balanced loads.

C. Make sure proper grounding and bonding are provided for fixtures and raceways.

D. Install specified lamps in each fixture.

E. When applicable, aim and adjust fixtures in accordance with directions as indicated on the Drawings.

F. Energize and test fixtures for proper operation.

G. Check the illumination level with a light meter and ensure that sufficient light is reaching areas where tasks are performed and that egress paths are properly illuminated during emergency situations.

END OF SECTION

SECTION 16618
CONDUIT

PART 1 DESCRIPTION

A. Furnish and place conduit.

PART 2 MATERIALS

A. Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of Item 16622, "Duct Cable."

B. When specified in the plans, provide:
1. rigid metal (RM) conduit that is hot-dip galvanized inside and outside with a minimum of 1.5 oz. per square foot of a zinc coating in accordance with Item 16445, "Galvanizing";
2. electrical metallic tubing (EMT) and intermediate metal conduit (IMC) that is steel, galvanized on the outside, and protected on the inside with a suitable corrosion-resistant material;
3. polyvinyl chloride (PVC) conduit that meets the requirements of NEMA Standard TC-2, UL 651, and the NEC;
4. high-density polyethylene (HDPE) conduit without factory-installed conductors that meets the requirements of Item 16622, "Duct Cable"; or
5. flexible conduit that is liquid-tight.

C. Unless otherwise shown on the plans, fabricate fittings such as junction boxes and expansion joints from a material similar to the connecting conduit. Use watertight fittings. Do not use set screw and pressure-cast fittings. Steel compression fittings are permissible. When using HDPE conduit, provide fittings that are UL listed as electrical conduit connectors or thermally fused using an electrically heated wound wire resistance welding method.

D. Use red 3 in. 4 mil polyethylene underground warning tape that continuously states "Caution Buried Electrical Line Below."

PART 3 CONSTRUCTION

A. Place conduit in accordance with the lines, grades, details, and dimensions shown on the plans or as directed. Install conduit a minimum of 18 in. deep underground unless otherwise shown on the plans. Meet the requirements of the NEC when installing conduit. Secure and support conduit placed for concrete encasement in such a manner that the alignment will not be disturbed during placement of the concrete. Cap ends of conduit and close box openings before concrete is placed.

B. Ream conduit to remove burrs and sharp edges. Use a standard conduit cutting die with a 3/4 in. taper per foot when conduit is threaded in the field. Fasten conduit placed on structures with conduit straps or hangers as shown on the plans or as directed. Fasten conduit within 3 ft. of each box or fitting and at other locations shown on the plans or as directed. Use metal conduit clamps that are galvanized malleable or stainless steel unless otherwise shown on the plans. Use 2 hole type clamps for 2 in. diameter or larger conduit.

C. Fit PVC and HDPE conduit terminations with bushings or bell ends. Fit metal conduit terminations with a grounding type bushing, except conduit used for duct cable casing that does not terminate in a ground box and is not exposed at any point. Conduit terminating in threaded bossed fittings does not need a bushing. Prior to installation of conductors or final acceptance, pull a spherical template having a diameter of at least 75% of the inside diameter of the conduit through the conduit to ensure that the conduit is free from obstruction. Cap or plug empty conduit placed for future use.

D. Perform trench excavation and backfilling as shown on the plans or as directed and in accordance with Item 02226, "Excavation and Backfill for Structures." Excavation and backfilling will be subsidiary to the installation of the conduit.

E. Jack and bore as shown on the plans or as directed, and in accordance with Item 16476, "Jacking, Boring, or Tunneling Pipe."

F. Place warning tape approximately 10 in. above trenched conduit. Where existing surfacing is removed for placing conduit, repair by backfilling with material equal in composition and density to the surrounding areas and by replacing any removed surfacing, such as asphalt pavement or concrete riprap, with like material to equivalent condition. Mark conduit locations as directed.

PART 4 MEASUREMENT

A. This Item will be measured by the foot of conduit.

B. This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal. Additional measurements or calculations will be made if adjustments of quantities are required.

PART 5 PAYMENT

A. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Conduit" of the type and size specified and the installation method specified as applicable. This price is full compensation for furnishing and installing conduit; hanging, strapping, jacking, boring, tunneling, excavating, and furnishing and placing backfill; replacing pavement structure, sod, riprap, curbs, or other surface; marking

location of conduit (when required); furnishing and installing fittings, junction boxes, and expansion joints; and equipment, labor, tools and incidentals.

B. Flexible conduit will not be paid for directly but will be subsidiary to pertinent Items. Unless otherwise shown on the plans, no payment will be allowed under this Item for conduit used on electrical services or in foundations.

END OF SECTION

SECTION 16620
ELECTRICAL CONDUCTORS

PART 1 DESCRIPTION

A. Furnish and place electrical conductors, except conductors specifically covered by other Items.

PART 2 MATERIALS

A. Provide new materials that comply with the details shown on the plans and the requirements of this Item. Use stranded insulated conductors that are rated for 600 volts; approved for wet locations; and marked in accordance with UL, NEC, and CSA requirements.

B. Ensure that all grounding conductors size AWG No. 8 and larger are stranded, except for the grounding electrode conductor, which will be a solid conductor.

C. Use white insulation for grounded (neutral) conductors, except that grounded conductors AWG No. 8 and larger may be black with white tape marking at every accessible location. Do not use white insulation or marking for any other conductor except control wiring specifically shown on the plans.

D. Ensure that insulated grounding conductors are green except that insulated grounding conductors AWG No. 8 and larger may be black with green tape marking at every accessible location. Do not use green insulation or marking for any other conductor except control wiring specifically shown on the plans.

PART 3 CONSTRUCTION

A. Splice conductors only in junction boxes, ground boxes, and transformer bases, and in poles and structures at the hand holes. Splice as shown on the plans. Do not exceed the manufacturer's recommended pulling tension. Use lubricant as recommended by the manufacturer. Install conductors in accordance with the NEC.

B. Make insulation resistance tests on the conductors prior to making final connections, and ensure that each continuous run of insulated conductor has a minimum DC resistance of 5 megohms when tested at 1,000 volts DC. The Owner's Representative may require verification testing of all or part of the conductor system. The Owner's Representative will witness these verification tests. Replace conductors exhibiting an insulation resistance of less than 5 megohms.

PART 4 MEASUREMENT

A. This Item will be measured by the foot of each single conductor.

B. This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal." Additional measurements or calculations will be made if adjustments of quantities are required.

PART 5 PAYMENT

A. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Electrical Conductors" of the types and sizes specified. This price is full compensation for furnishing, installing, and testing electrical conductors and for equipment, labor, tools, and incidentals, except that:

1. conductors used in connecting the components of electrical services will be paid for under Item 16628, "Electrical Services";

2. conductors inside roadway illumination assemblies will be paid for under Item 16610, "Roadway Illumination Assemblies"; and

3. conductors used for internal wiring of equipment will not be paid for directly but will be subsidiary to pertinent Items.

END OF SECTION

SECTION 16628

ELECTRICAL SERVICES

PART 1 DESCRIPTION

1.01 INSTALLATION

A. Furnish and install complete and independent points of electrical service.

1.02 REMOVAL

A. Remove electrical services.

PART 2 MATERIALS

A. Provide materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

1. Item 16441, “Steel Structures”
2. Item 16445, “Galvanizing”
3. Item 16449, “Anchor Bolts”
4. Item 16618, “Conduit”
5. Item 16620, “Electrical Conductors”
6. Item 16627, “Treated Timber Poles”
7. Item 16656, “Foundations for Traffic Control Devices.”

B. For the installation of electrical services, use new materials that meet the requirements of the NEC, UL, CSA, and NEMA.

PART 3 CONSTRUCTION

A. Perform work in accordance with the details shown on the plans and the requirements of this Item.

3.01 INSTALLATION

A. Ensure components of the electrical service meet the requirements of the Electrical Detail Standards. Follow NEC and local utility company requirements when installing the electrical equipment. Coordinate the utility companies’ work for providing service.

3.02 REMOVAL

A. Coordinate removal with the appropriate utility company before beginning work. Before the removal of the electrical service, disconnect and isolate any existing electrical service equipment in accordance with the utility company's requirements.

B. Use established industry and utility safety practices while removing electrical service equipment near any overhead utilities.

C. Remove existing electrical service support a minimum of 2 ft. below finish grade unless otherwise shown on the plans. Repair the remaining hole by backfilling with material equal in composition and density to the surrounding area. Replace any surfacing such as asphalt pavement or concrete riprap with like material to equivalent condition.

D. Disconnect conductors and remove them from the conduit or duct. Cut off all protruding conduit or duct 6 in. below finish grade. Abandoned conduit or duct need not be removed unless shown on the plans.

E. Reconnect duct cable, conductors, and conduit to be reused when shown on the plans. Make all splices in ground boxes unless otherwise shown on the plans.

F. Accept ownership of unsalvageable materials, and dispose of them in accordance with federal, state, and local regulations.

PART 4 MEASUREMENT

A. This Item will be measured by each electrical service installed or removed.

PART 5 PAYMENT

A. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Electrical Services" of the types specified or "Remove Electrical Services."

5.01 INSTALLATION

A. This price is full compensation for paying all fees, permits, and other costs; making arrangements with the utility company for all work and materials provided by the utility company; furnishing, installing, and connecting all components including poles, service supports, foundations, anchor bolts, riprap, enclosures, switches, breakers, conduit (from the service equipment including the elbow below ground), fittings, conductors (from the service equipment including the elbow below ground), brackets, bolts, hangers, and hardware; and equipment, labor, tools, and incidentals.

5.02 REMOVAL

A. This price is full compensation for coordinating with the utility company to disconnect and isolate the electrical service; removing the service supports; backfilling holes; and equipment, labor, tools, and incidentals.

END OF SECTION

SECTION 16740

TELEPHONE SERVICE ENTRANCE

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of a telephone service entrance.

B. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

C. See Section 16012, Electrical Work, paragraph entitled Submittals, for submittal requirements.

1.2 REFERENCES

A. Local Telephone Company Standards.

B. Telephone Service Provider Company Standards (for SCADA lines).

1.3 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.

PART 2 - P R O D U C T S

2.1 TELEPHONE SERVICE

A. Provide as indicated on Drawings and as required by Telephone Utility.

B. Autodialer lines shall be standard voice grade dial out/in telephone line. Special type lines are not to be installed unless specifically approved by Engineer in writing.

C. Notify Engineer in writing of type line ordered immediately after order is placed and before it is installed. Provide Telephone Company contact name, installation order number, installation date, quoted installation cost estimate and monthly line charges for each separate line.

D. Provide for either aerial or underground service, whichever is offered by Telephone Company and, include sufficient amount in bid cost to cover the most stringent condition.

2.2 MATERIALS

A. Service Entrance: Conduit shall be 2 inch, unless shown larger on plans.

B. Conduit System:

1. Comply with Section 16111, Conduit, Fittings, and Bodies.
2. Provide grounding bushings on conduits at terminal boards.
3. Conduit shall be provided from Telephone Company point of service to a point outside building near MCC room, to allow installation of Telephone Company terminal box on side of building.

C. Terminal Cabinets: Comply with Section 16135, Cabinets, Boxes, and Fittings.

D. Outlets: Outlet plates to match telephone jacks.

PART 3 - E X E C U T I O N

3.1 PREPARATION

A. Telephone Service:

1. Consult with Telephone Utility to verify service information for installation specified herein and shown on drawings.
2. Assist Owner in ordering proper telephone service for autodialer applications and maintain contact with Telephone Company for final coordination and installation of lines on schedule. Order shall be placed within thirty (30) days after award of contract. Failure to do so will be at expense of Contractor and Engineer or Owner may require this service be provided by others and billed to Contractor. Notify Engineer and Owner of scheduled installation date.
3. Telephone service installation and monthly charges for autodialer will be paid by Owner, except where bid "allowance" is indicated or, except where noted otherwise on plans or in other specifications. Autodialer line charges will be paid for by Owner.
4. Contractor shall coordinate telephone service application and installation and shall be responsible for timely application for service. Contractor shall direct telephone company installer to route Telephone Company cable in Owner provided conduit to building and install the Telephone Company terminal box on outside wall, or where no building is present, install at main electrical service rack.
5. Contractor shall have proper equipment and trained technicians for testing telephone lines for satisfactory installation once lines are installed by Telephone Company or, shall contract this service to a technically qualified firm who can test lines.

3.2 INSPECTION

Examine areas and conditions under which telephone service entrance and conduit system is to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work.

3.3 INSTALLATION

A. Install conduit system and service entrance as shown on Drawings and in accordance with Section 16111, Conduit, Fittings, and Bodies.

B. Terminate service conduit in telephone equipment area at mounting panel as indicated on Drawings.

C. Install telephone cable in conduits. Provide cable with minimum two (2) pair spares plus one (1) pair for ATD and one (1) pair for controller testing.

D. Telephones and cables up to service point to be by Telephone Utility. Coordinate ditching, supplying, and backfilling with Telephone Utility.

3.4 TESTING

Contractor shall test lines with proper test equipment and verify line is satisfactory and ready for applying signals.

END OF SECTION

SECTION 16935

TELEPHONE AUTOMATIC DIALER SYSTEM

PART 1 - G E N E R A L

1.1 SECTION INCLUDES

A. This section includes the requirements for the provision of a telephone automatic dialer system.

B. Refer to Section 16012, Electrical Work, paragraph entitled Contractor's Responsibilities, for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

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. See Section 16012, Electrical Work, paragraph entitled Submittals, for submittal requirements.

1.2 SYSTEM DESCRIPTION

A. Design Requirements:

1. Electronic system shall interface plant alarms to public telephone system on pre-selected basis.
2. Upon receipt of one or more critical alarm trips, electronic system will automatically dial out onto public phone system (up to 16 specified telephone numbers) with preprogrammed messages.
3. System shall continue calling until call completed and acknowledged.
4. Description & Phone Number Dialing: The dialer shall be a solid state component capable of dialing up to 16 phone numbers, each up to 24 digits in length. Phone numbers and Standard pulse dialing or Touch Tone DTMF dialing are user programmable via the system's keyboard or Touch Tone Phone.
5. Solid State Voice Message Recording and Playback:
   a. The unit shall have two different categories of speech message capability, all implemented with permanent non-volatile solid-state circuitry with no mechanical tape mechanisms. The unit shall allow for message recording from a remote telephone as well as from the front panel.
   b. User Field Recorded Messages: The user may record and re-record his own voice messages, for each input channel and for the Station ID.
   c. There shall be no limit on the length of any particular message, within the overall available message recording time, which shall be 40 seconds for four channel units; 80 seconds for eight channel units, and 160 seconds for 16 or more channels.
   d. The unit shall allow selective recording of both Normal and Alarm advisory messages for each input channel.
   e. The unit shall provide for automatic setting of the optimum speech memory usage rate for the total set of messages recorded, in order to achieve optimum recording sound quality.
   f. Circuit board switches or jumper straps shall not be acceptable means of manipulating message length or recording rates.
   g. Permanent Resident Non-Recorded Messages: Permanent built-in messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the installer has not recorded any messages of his own.
6. Nonvolatile Program Memory Retention: User-entered programming and voice message shall be kept intact even during power failures or when all power is removed for up to ten years.

7. Acknowledgment: Acknowledgment of an alarm phone call is to be accomplished by pressing a Touch Tone "9" as the alarm call is being received, and /or by returning a phone call after received an alarm call.

8. Input Monitoring Function: The unit shall continuously monitor the presence of AC power and the status of multiple contact closure inputs. Unit shall optionally be field upgradeable to incorporate a total of 8, 16, 24, or 32 dry contact inputs. AC power failure, or violation of the alarm criteria at any input, shall cause the unit to go into alarm status and begin dial-outs. Unit shall, upon a single program entry, automatically accept all input states as the normal non-alarm state, eliminating possible confusion about Normally Open versus Normally Closed inputs. Further, as a diagnostic aid, unit shall have the capability of directly announcing the state of any given input as currently "Open Circuit" or "Closed Circuit," without disturbing any message programming. Each input channel shall also be independently programmable, without need to manipulate circuit board switches or jumpers, as Normally Open or Normally Closed, or for No Alarm (status only), or for Pulse Totalizing, or for Run Time Metering.

9. Alarm Message: Upon initiating an alarm phone call, the system is to "speak" only those channels that are currently in "alarm status."

10. Diagnostics: The unit shall provide a complete verbal report of all programmable functions and their programmed values on command from any remote Touch Tone phone.

11. Speakerphone: The unit shall be capable of dialing any phone number on command and function as a speakerphone.

12. Inquiry Message and Function: Inquiry phone calls can be made directly to the unit at any time from any telephone, locally or long distance, for a complete status report of all variables being monitored, including power status.

13. Provide unit with means for data line communication of alarm input signals from PC, RTU or other data source. Provide all programming of both source and autodialer systems as required for operation.

14. Provide six (6) each additional spare input modules above the total inputs required for this project.

15. Cellular Phone Communications:

    a. Where cellular phone communication is required, provide CDMA 800+ 1900 MHz cell phone with battery back-up or provide GSM factory installed quad-band GSM cell phone with battery back-up. (Verify telephone service provider with Owner.)

    b. Provide EXTANKIT external omni-directional antenna kit with antenna cables, surge suppressor, and 1020 foot, 2 inch aluminum mast attached to structure.

PART 2 - P R O D U C T S

2.1 MANUFACTURERS

A. Raco

B. Or pre-approved substitution.

2.2 DIALER

A. Model: Verbatim

B. Enclosure: NEMA 12 indoor and NEMA 4X outdoor surface mount.

C. Remote Reset: Alarm acknowledged by either depressing touch-tone key or calling dialer back when alarm acknowledged from non-touch-tone telephone.

D. The dialer is to use a standard rotary pulse or Touch Tone "dial-up" phone line (direct leased line not to be required) and is to be F.C.C. approved. Connection to the telephone is through a 4-pin modular jack (RJ-11).

E. All power, phone line, dry contact, and analog signal inputs shall be protected at the circuit board IEEE Standard 587, category B (6,000 volts open circuit/3,000 amps closed circuit). Gas tubes followed by solid state protectors shall be integral to the circuit board for each such line. Protectors mounted external to the maincircuit board shall not be an acceptable substitute. The installer shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.

F. Operating Temperature: 32 F to 160 F.

G. Operating Humidity: 0% to 90%.

H. Output: To standard phone line through integral FCC approved alarm coupler.

I. Power: 120 vac, 60 Hz.

J. 20 hour battery backup.

K. All features per manufacturers catalog data.

L. Provide inputs for all alarm signals indicated on plans and in specifications, plus 25 percent spares.

M. Vendors for equipment with solid-state controller shall include provisions for both hardwired and datapath status, command and alarm functions included under contract without additional cost to Owner or Engineer.

PART 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved submittals.

B. Wire each device, program test, and utility unit to be suitable for operation.

C. Contractor shall provide fail and problem alarms for all devices, equipment, controls, and generator and route to autodialer. Provide expansion modules and programming as required. Provide eight (8) additional alarm circuits conductors from MCC controls section to autodialer.

D. Route normal alarms from SCADA System CCU or RTU to autodialer via data line connection. Use Ethernet switch or router where required.

E. Route all critical alarms to autodialer via relay contact direct from devices at MCC and/or control panel.

F. Manufacturer’s Representative is to program unit per Owner’s instructions. Coordinate with solidstate controllers where RS485/RS232 interface.

G. Vendors for equipment with solid-state controller shall include provisions for both hardwired and data path status, command and alarm functions included under contract without additional cost to Owner or Engineer.

END OF SECTION

SECTION 16936

PILOT AND MISCELLANEOUS CONTROLDEVICES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Pilot and control devices for instrumentation and control (I&C) system.

B. Products listed are applicable where indicated on plans or required in other specifications.

C. Refer to Section 16012 - "Electrical Work" for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

D. All equipment and devices shall be NEMA rated. IEC rated equipment and devices are not acceptable.

E. 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. See Section 16012 – "Electrical Work," for submittal requirements.

PART 2 P R O D U C T S

2.1 PUSHBUTTON/SELECTOR SWITCH CONTROL UNITS AND PILOT LIGHTS

A. Manufacturers:

1. Square D Class 9001, Type K
2. Cutler-Hammer 10250T
3. Allen Bradley 800T
4. Or, pre-approved equal

B. Construction:

1. Heavy duty
2. Watertight
3. Oiltight
4. Base mounting
5. Flush panel mounting
6. Size to mount in 30.5 mm diameter opening without adapter. Smaller units are not acceptable.
7. Padlock attachments, where required, constructed of metal. Plastic material is not acceptable.
8. Legend plates, as required, for type of operation or as specified elsewhere.

C. Pushbuttons:

1. Flush head unless specified elsewhere.
2. Contact Blocks:
   a. Double break silver contacts
   b. AC Ratings: 7,200 VA make, 720 VA break
   c. Single pole, double throw or double pole, single throw
   d. Up to six (6) tandem blocks
3. Maintained contact unless specified elsewhere.
4. Non-illuminated.
5. Legend plates, as required, for type of operation or as specified elsewhere.

D. Selector Switches:

1. Maintained position unless specified elsewhere
2. Contact Blocks:
    a. Double break silver contacts
    b. AC Rating: 7,200 VA make, 720 VA break
    c. Single pole, double throw or double pole, single throw
    d. Up to six (6) tandem blocks
3. Operators:
    a. Number of positions as specified elsewhere
    b. Standard knob type unless specified elsewhere

E. Pilot Lights:

1. LED, high visibility type
2. Colored lenses as specified elsewhere
3. Interchangeable lenses
4. Push to test
5. Legend plates as specified elsewhere

F. Enclosures:

1. Mounted in control or instrument panel as specified elsewhere
2. Control Station:
    a. Environment:
        1) NEMA 12 in general areas
        2) NEMA 4X 316 stainless steel in wet locations or outdoors.
    b. Flush or surface mounted as specified elsewhere.
        1) Provide flush mounted pull box.

G. Nameplates:

1. Control Stations:
    a. Engraved laminated plastic
    b. Letters 3/16 in. high
    c. White letters on black background
    d. Identify per equipment controlled

2.2 MOTOR STARTER CONTROL RELAYS

A. Manufacturers:

1. Square D
2. Cutler Hammer
3. Or pre-approved equal

B. Construction:

1. Industrial type
2. 300 V rated
3. AC operation
4. Pressure wire connectors

C. Operating Data:

1. Pickup Time: 11 ms maximum
2. Dropout Time: 6 ms maximum

D. Coil:

1. Molded construction 2. 120 VAC, 60 Hz
3. Continuous rated
4. Color coded to indicate status
5. Pilot duty
6. 60A make, 6A break, (120 V inductive)

E. Contacts:

1. Double break
2. Silver alloy
3. Convertible
4. Color coded to indicate status
5. Pilot duty
6. 60A make, 6A break, (120V inductive)

F. Track mounting capability.

G. Accessories:

1. Add-on pole attachment:
   a. 4 NO and 4 NC contacts
   b. Add-on to 0 to 4 pole relay
2. Latch attachment.
3. Pneumatic Timer Attachment:
   a. Single pole, double throw, double break timed contact.
   b. Adjustable 0.2 to 60 sec.
   c. Repeat accuracy of $\pm$ 15 percent.
   d. Convertible timing mode.
4. Transient Timing Mode: Suppress coil transients to 300 V or less.

H. All relays to be 4PDT type.

2.3 CONTROL RELAYS

A. Manufacturers:

1. Potter and Brumfield
2. Struthers Dunn
3. Or pre-approved equal

B. Operating Data:

1. Pickup Time: 13 ms maximum.
2. Dropout Time: 10 ms maximum.
3. Operating Temperature: -45°C to 70°C.

C. AC Coil:

1. 120 or 240 Vac.
2. Continuous rated
3. 3.5 VA inrush
4. 1.2 VA sealed
5. 50 to 60 Hz
6. Minimum Dropout Voltage: 10% of coil rated voltage.

D. DC Coil:

1. 24 or 120 Vdc.
2. Continuous rated
3. Minimum Coil Resistance
   a. 24 Vdc: 450 ohm
   b. 120 Vdc: 9,000 ohm

E. Contacts:

1. Silver cadium oxide for 1 amp or less resistive load
2. Gold flashed fine silver, gold diffused
3. 4 Form C
4. 120 VAC
5. 20 amp make, 1.5 amp break (inductive)

F. Rated at 10 million operations

G. Plug-in sockets

H. Enclosed and protected by polycarbonate cover

I. Provide relay retaining clips.

J. All relays to be 4PDT type.

2.04 TIME DELAY RELAY

A. ATC # 319D-016, with 2 SPDT switches rated 5 amps at 120 Volt, contacts and coil, plug in base and socket, 5 ranges, .02 seconds to 30 minutes.

B. AGASTAT #7022AC, Instantaneous open on energization, time delay close on de-energization. Time range 1.5 seconds to 15 seconds, 120 volt, 60 Hz

C. ATC Model #319D-134, with 2 S.P.D.T. switches rated 5 Amps at 120 Volt, contacts and coil, plug in base and socket, 3 ranges, .1 to 100 seconds.

D. Macromatic Industrial Controls, Model #TAA1U, with two (2) S.P.D.P. switches rated 3 amps at 250 volt contacts, 24-240VAC/DC coil, plug-in base, six (6) functions, sixteen (16) ranges, 0.5 seconds to 10 hours.

E. Or approved equal

2.5 ELAPSED TIME METER

A. Manufacturers:

1. Cramer #635G/HRS.
2. Digits: Five (5), non-resettable.
3. Power: 120 VAC, 60 Hz.

B. Manufacturers:

1. Cramer #635S surface mounted.
2. Digits: Five (5), non-resettable
3. Power: 120 VAC, 60 Hz

2.6 TIMERS

A. 24 Hour Clock Timer (Repeat Cycle):

1. Manufacturers:
   a. Tork Time Controls
   b. Intermatic
   c. Or pre-approved equal
2. Mounting: Surface
3. Display: 24-hr LCD
4. Contacts: One (1) SPDT rated 20A
5. Set Points: 288 per 24 hr.
6. Skip Feature: 1 to 7-day adjustable
7. Minimum On-Off Time: 5 min.
8. Time cycle programmable by keypad
9. Power: 120 VAC, 60 Hz

B. Interval/Duration Timer:

1. Manufacturers: ATC or equal.
2. Mounting: Plug-in with dust tight cover
3. Type: Integrated circuit
4. Range: As indicated on drawings
5. Contacts: Two (2) DPDT contacts rated 10 amp
6. Power: 120 VAC, 60 Hz.

2.7 EXTERIOR MOUNTED ALARM LIGHT

A. Manufacturers:

1. Edwards
2. Appleton Electric Company
3. Crouse Hinds
4. Or pre-approved equal

B. 120 VAC

C. Suitable for use in wet location, gasketed.

D. Cabinet mounted, provide mounting lugs. Body to include outlet box.

E. Aluminum mounting hood.

F. Red glass globe with guard.

G. ¾ inch conduit hubs

2.8 EXTERIOR MOUNTED ALARM HORN

A. Manufacturers:

1. Edwards
2. Or, pre-approved equal.

B. 120 VAC

C. Suitable for use in wet location, gasketed.

D. Cabinet mounted, provide mounting lugs. Body to include outlet box.

E. Aluminum mounting hood.

F. ¾ inch conduit hubs

2.9 ROTATING BEACON

A. Manufacturers:

1. Edwards: 40 Watts, 75 FPM, 120 Volt, 50-LMP, 4CW lamp red acrylic dome lens, Edwards #52R-N5 40W with wall mounted bracket Edwards #WBR.

2.10 ALTERNATOR

A. Manufacturers:

1. Diversified Electronics:
   a. Two (2) Pump Duplexor:
      1) 24 VAC/DC, ARA-24-ABA.
      2) 48 VDC, ARA-48-ABA
      3) 120 VAC/DC, ARA-120-ABA
      4) 208 VAC, ARA-208-ABA
      5) 240 VAC, ARA-240-ABA
   b. Three (3) Pump Triplexor:
      1) 24 V, ARA-24-AFE 2) 120 V, ARA-120-AFE
   c. Four (4) Pump Quadraplexor:
      1) 24 V, ARA-24-AGE 2) 120 V, ARA-120-AGE
   d. Two (2)/Three (3) Pump Duplexor/Triplexor: 120 V, ARA-120-AME
   e. Three (3)/Four (4) Pump Triplexor/Quadraplexor: 120 V, ARA-120-ANE
   f. Five (5)-Pump Pentaplexor: 120 V, ARP-100
   g. Six (6)-Pump Hexaplexor: 120 V, ARA-100

2. Time Mark Corporation: 120 V, B 471
3. Macromatic Industrial Controls: Two (2) pump duplexor, 120 volt, ARP120A6, 240 volt, ARP240A6
4. Or equal as pre-approved by Engineer

B. Provide automatic alternation of energizing motor starters.

C. Permit operation of units singly or together as called by pilot devices.

D. N.O. auxiliary contacts from motor starters required to operate alternator.

E. Alternator shall provide for operation of standby or lag unit through second pilot device in event of failure of lead unit or first pilot device or alternator coil.

F. With pump selector switch for operation of two (2), three (3), four (4) and five (5) pump systems.

2.11 PHASE FAIL PROTECTION DEVICES

A. Diversified Electronics Model #SLD-440-ALE, 480 Volt, 3 Phase.

B. Diversified Electronics Model #SLD-220-ALE, 240 Volt, 3 Phase.

C. Macromatic Industrial Controls, Model #PMDU, 208-480 Volt, 3 Phase

2.12 FLOAT SWITCH

A. Wastewater / Non-Potable Use:

1. Manufacturers:
   a. Anchor Scientific
   b. Pre-approved equal.
2. Construction:
   a. Direct acting.
   b. Polyprosylene body.
   c. Form C type contact mercury switch.
   d. 10 amps at 230 VAC maximum.

B. Potable Water Use:

1. Manufacturer:
   a. U.S. Filter
   b. Pre-approved equal
2. Construction:
   a. Model 9GEF, mercury free

2.13 DC INPUT, FIELD CONFIGURABLEISOLATOR

A. Manufacturer:

1. Action Instruments, Model ACTIONI/Q Q406
2. Or, approved equal.

B. Construction:

1. Provides one or two fully isolated DC output signals in proportion to one or two DC inputs.
2. Field Configurable: 4-20 ma, 0-1 ma, 0-10V or 0-20 ma.
3. 120 V power source.

2.14 SUBMERSIBLE LEVEL TRANSDUCER

I. Non-Potable Water Application:

A. Manufacturer:

1. CA Briggs
2. Mercoid
3. Pre-approved equal
4. Contegra

B. Model: Contegra SLX 130 submersible level transducer.

C. Provide transient protector for the transducer.

D. Power: 10 - 30 VDC

E. Output: 4-20 mA.

F. Accuracy: plus/minus 0.25 percent of calibrated span, minimum.

G. Range: 0.2 to 100 meters of H_2O, minimum.

H. Sensor: Flush mounted ceramic.

I. PVC body.

J. Cable: Heavy duty, submersible rated with strain relief device.

K. Cable Length: Wet well depth plus length to terminal box with 10 feet slack coiled in terminal box (not in wet wells).

L. Kellum grip with protective bushing. Suspend on stainless steel cable clear of pump and 4 inches above intake. Clamp transducer cable to stainless steel cable with suitable stainless steel clamps at 24-inch intervals. Provide epoxy coated lead weight at end of stainless steel cable. Provide stainless steel cable strain relief device at transducer that fits threaded connection at transducer, and that has ring for support by stainless steel cable.

2.15 SIGNAL CONVERTER/ISOLATION AMPLIFIER

A. Manufacturers:

1. MCR-C Series manufactured by Phoenix Contact.
2. AKT Series manufactured by Wieland Manufacturing.

B. Voltage to current and current to voltage conversion.

C. Current to current isolation amplifier.

2.16 INTRUSION SWITCHES

A. Doors:

1. On all entrance doors for alarm switch and, on MCC and control panel doors for intrusion or light operation, install Model E700, DPDT switch as manufactured by ERSCE except where shown otherwise on plans.

2. MicroSwitch, applicable model, where indicated on plans.
3. Special Applications:
   a. Where indicated on Plans for loose fitted doors and/or for areas where subject to damage, install GRI Model 4400 magnetic switches with stainless steel cable.

B. Overhead Rollup Doors:

1. For overhead door applications, install ADEMCO Model 958-2 Magnetic OHD Contractor, or approved equal.

2.17 SUBMERSIBLE PUMP PROTECTION MODULE

A. Flight MiniCAS II: Model No. 83 58 57 (24 volt), 40-50 10 98 (120 volt); MiniCAS II/FUS Model No. 14-40 71 13 92 (24 volt).

B. Module shall be capable of monitoring temperature via a thermal switch embedded in motor winding, and capable of detecting leakage via sensor located in pump.

C. Temperature detection to operate Form "C" 10 amp contact, such that when wired into pump controls will shut down pump when over-temperature condition is detected.

D. Leakage detection to operate Form "C" 10 amp contact, such that when wired into pump controls will initiate alarm.

E. 20-30 VAC, 50-60 Hz with 24 volt external power supply, or 120 VAC, 5-60 control power source.

F. LED indicators for over-temperature and leak indications.

G. Manual reset pushbutton to interrupt power supply.

H. Model No. 14-50 70 97 Socket

I. Temperature Range: 0-50° C (32-123° F), Max 90% RH

2.36 MODBUS Ethernet Serial Server

A. Manufacturer:

1. B & B Electronics.

B. Models:

1. MESA1A, MES1B.

C. Dimensions:

1. MES1A/MES1B – 1.25 x 4.5 x 4.75 in (3.2 x 11.3 x 12.2 cm).

D. Power Supply Requirements:

1. 10VDC to 30VDC @ 3.6W.

E. Power Consumption:

1. 12VDC @300 mA.

F. Operating Temperature:

1. -20 to 80 °C (-4 to 176 °F).

G. Humidity:

1. 10% to 90% R.H. non-condensing.

H. Ethernet:

1. Single RJ-45 female (with built-in LED indicators).
2. IEEE 802.3 10/100 Mbps auto-detecting, 10BaseT, 100BaseTX.
3. TCP, UDP, DHCP, SNMP, TELNET, ICMP, ARP, TFTP, Modbus ASCII, Modbus RTU, Modbus/TCP

I. Serial:

1. 12V TVS for MES1A.
2. MES1A – 9 pin D-type male (DB-9M).
3. 5 V TVS for MES1B.
4. MES1B removable screw terminal (5) block with screw down.

J. Interface Lines Supported:

1. MES1A – RS-232 TD, RD, GND.
2. MES1B – RS-422-485 TDA(-), TDB(+), RDA(-), RDB(+), GND.

K. Configuration Modes:

1. Telnet, XPort Device Installer with integrated Telnet.

L. Device Management:

1. SNMP – RFC 1213-1215-1316-131.

2.18 TAGGING

A. Provide Type 316 stainless steel tag on field-mounted units and permanently affix tag to unit.

B. Include Engineer's tag number where listed in Control Diagrams.

C. See Section 16195 – "Electrical Identification" for additional requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA "Standard of Installation," and recognized industry practices.

B. Control Relay:

1. Install panel control relays in I&C panel.
2. Install motor starter control relays in MCC and wherever more rugged type relay required.

END OF SECTION